DOCUMENT RESUME

ED 157 707 SE 024 511

TITLE Science Curriculum Guide, Primary Grades: K-3. Curriculum Bulletin Number 25.
INSTITUTION Cincinnati Public Schools, Ohio. Dept. of Instruction.
PUB DATE 76
NOTE 632p.; For related document, see SE 024 512; Contains occasional light and broken type

EDRS PRICE MF-$1.16 HC-$34.15 Plus Postage.
DESCRIPTORS Biological Sciences; *Curriculum; Earth Science; Elementary Education; *Elementary School Science; Instruction; Learning; Physical Sciences; *Primary Education; *Science Education; Ungraded Curriculum
IDENTIFIERS *Ohio (Cincinnati)

ABSTRACT

This publication is designed as a guide for the instructional program in science. The first part contains performance goals and conceptual schemes. Emphasis is placed on the teaching of science as content and as process. The processes outlined are: observing, classifying, measuring, inferring, predicting, and identifying variables. Experimental work is stressed where the classroom and the community as a whole serve as a laboratory for the children. The interrelation of science with other areas of the curriculum is encouraged, especially those learning activities which are appropriate for career motivation. The units in the guide are not grade-placed but represent a four-year span, K-3. They include the three major strands of science: Physical, Earth, and Life Science. For each strand, the concepts, performance objectives, materials, and learning activities are stated in detail. Evaluation is to be a continuous but informal activity on the part of the teacher. (GA)

****

* Reproductions supplied by EDRS are the best that can be made *

* from the original document. *

****

U S DEPARTMENT OF HEALTH.
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

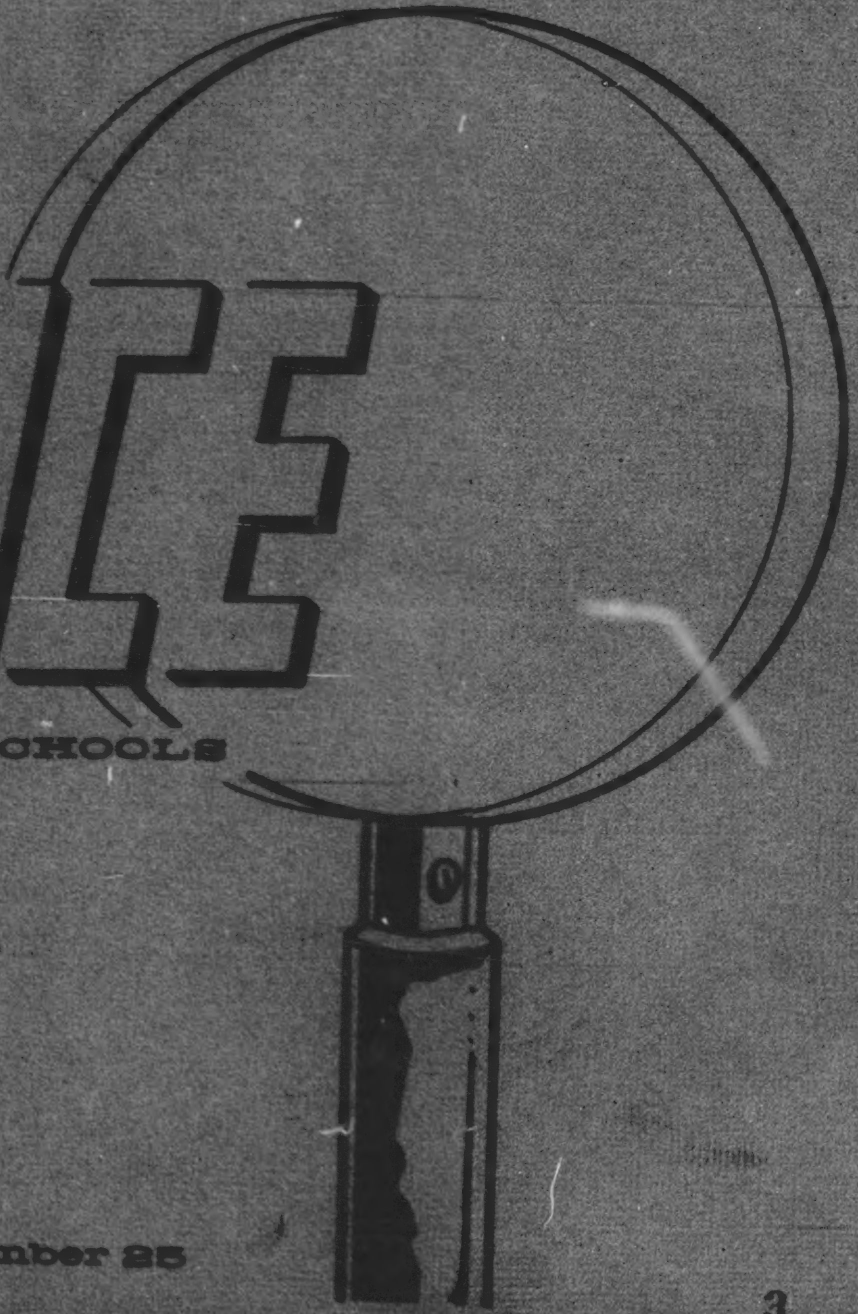
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Ralph Shauck

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

ED157707

SCIENCE



CINCINNATI PUBLIC SCHOOLS

Grades K-3

1976

Curriculum Bulletin Number 25

SE 024 511

FOREWORD

The Science Curriculum, K-3, is a guide for the instructional program in science in the Cincinnati Public Schools. It provides teachers and administrators with the scope and sequence of the science program and promotes sound educational practices. The units provide the teacher with background, activities, and resources used to develop pertinent science topics.

A K-12 committee developed the conceptual schemes. A curriculum committee composed of primary teachers worked to develop this guide. Members of this committee are listed below.

Science Curriculum Committee, K-3

Dick, Audrey (1968-75), Adviser

Bellas, Jill (1971-72)

Cavanaugh, Nancy (1972-74)

Crittenden, Marjorie (1971-74)

Elder, Patricia (1969-70)

Funk, Bonnie (1972-74)

*Hafenbritle, Joan (1968-74)

*Hensel, Joyce (1969-74)

*Kareth, Betty (1970-74)

Little, Patricia (1969-70)

Miller, Helen (1971-74)

Mitchell, Nancy (1971-74)

Orr, Annie (1969-72)

Reed, Gladys (1972-74)

*Robertson, Caroline (1971-74)

Rohe, Marcia (1971-72)

Rollinson, Dorothy (1972-74)

Schweitzer, Marta (1971-72)

Walker, Janet (1971-72)

In addition to the above committee, acknowledgment is made for the contributions of John Rodak, design of cover and sectional pages, Rosemary Bredestege, graphic assistance, and Don Schroeder, photography.

*Summer 1975

TABLE OF CONTENTS

Page

Science in the Elementary School Program vii

Introduction vii

Point of View vii

Goals vii

Conceptual Schemes, K-12 viii

Processes in Science, K-3 ix

Classroom As a Laboratory xii

Community As a Laboratory xii

Science and Other Curriculum Areas xiii

Science and Career Motivation xiii

Role of the Teacher xiv

Role of the Principal xiv

Organization of the Guide xv

Evaluation xvi

Time Allocation xvi

Physical Science 1

All About Objects 4

Light 28

Page

- Sound 47
- Moving Objects and Forces 69
- Simple Machines 82

Earth Science 101

- Rocks and Minerals 105
- Soil 125
- Fossils and Dinosaurs 150
- Air 161
- Water 183
- Weather 207
- Objects in the Sky 233

Life Science 267

- Plant Organisms 271
- Animal Organisms 289

7

SCIENCE IN THE ELEMENTARY SCHOOL PROGRAM

Introduction

The scientific and technological revolution has produced an explosion of knowledge that has stimulated a rapidly changing society. Society, in turn, demands an education designed to meet the challenge of change. This requires scientifically literate citizens--citizens who know the role of science in society, citizens who understand the conceptual schemes and investigative procedures of science, and citizens who make political and social decisions based on science knowledge. The development of scientific literacy can be accomplished through a continual systematic program from kindergarten through grade 12.

Point of View

The study of science not only contributes to children's knowledge about the physical world, but helps to develop thinking and inquiry skills which nurture their intellectual development.

In recent years, the emphasis in science education has been placed on the interaction of science and the learner. Science is both content and process. Process is the method of science. It involves thinking skills and the strategies of inquiry. Science processes are general learning skills that contribute to the total education of children. In a very real sense, children involved in science are learning how to learn. This curriculum is designed to involve children in a variety of processes that are essential in developing the inquiry skills through which facts and concepts are learned and attitudes and values are formed.

Goals

This science program reflects what is known about child development, the nature and needs of society, and the application of science in meeting the needs of children and society. It is directed toward the following goals:

1. To nurture the development of intellectual skills.

   As children work with objects and experience events in the physical environment, they are confronted with problem situations. These arouse their curiosity, stimulate their interest, and motivate them to seek solutions and understanding. As children investigate, gather evidence, evaluate the evidence, and draw conclusions, they are challenged to think logically and critically.

2. To help children develop skills in using the processes of science.

   Children learn by thinking about those objects and events they have perceived through their senses. As they observe, describe, classify, record, interpret, infer, hypothesize, experiment, and draw conclusions, they are using the same processes scientists use. Processes cannot be taught directly or vicariously. As children engage in many direct experiences with objects and events, they begin to internalize the science processes.

3. To help children develop science concepts.

Concepts are ideas and principles which provide the basis for interpreting many events. Facts and information should not be memorized, but serve as input for the development of concepts. Concepts developed through inquiry and discovery generally are more vivid and more durable than those told to children.

4. To help children develop attitudes and values consistent with the processes and content of science.

Science experiences enable children to view problems from more than one frame of reference, consider the ideas of others, develop the willingness to change their minds in light of new evidence, distinguish between fact and fancy, and deal rationally with problems.

5. To help children develop appreciations and values.

There are many aspects of science which children should learn to appreciate; for example, the contributions people have made to the body of science knowledge; the patterns and regularity of the universe; and the beauty in nature. Science education should nurture respect for life and should be directed toward improving the quality of life.

6. To apply science to the world in which we ~~life.~~ live.

The teacher must make science relevant to the children and stress its relationship to the real world. Efforts should be directed toward building understanding of the nature of modern technology and its impact on the environment of the earth and the universe. Conservation of irreplaceable natural resources and protection of endangered species are vital.

7. To educate pupils of varied needs.

Science education is directed toward building scientific literacy in our society as a whole. This includes the college-bound, the science-oriented worker, the non-science-oriented worker, and the general citizenry. It should contribute to their sense of satisfaction in leisure time pursuits.

Conceptual Schemes, K-12

This curriculum, K-3, is based on conceptual schemes developed K-12. Conceptual schemes are invented by people. They are formed by relating many concepts to a larger, more encompassing whole. Probably the most unchanging conceptual scheme is that everything in the universe is in constant change. These conceptual schemes are not concepts to be taught directly to children, but are broad generalizations upon which the topics and learning activities have been built, K-12. These schemes cut across the various strands of science--physical, earth, and life. As children progress from kindergarten through the secondary schools, science education will center on these conceptual schemes. Obviously, the treatment and depth of understanding will vary with children of differing ages and abilities.

The following schemes serve as a rationale for the content and objectives of the curriculum.

There is a relationship between structure and function.

All life affects and is affected by the interactions that occur in the universe.

The sum of matter and energy in the universe remains constant.

The universe is in continuous interaction and change.

The knowledge and processes of science are accumulating at an ever-increasing rate.

Matter and energy in the universe exist in units, kinds, and forms of varying sizes and complexity.

Man uses certain processes to examine the universe.

Man uses the knowledge and processes of science for decision-making and to regulate the environment.

Science and technology have created many career opportunities.

Processes in Science, K-3

Science is both content and process. Content refers to the body of science knowledge--facts, concepts, and generalizations. It consists of objects and events in the physical world. Processes are the methods by which one obtains knowledge. Experiences with objects and events enable the child to acquire the processes that are essential for learning science content. By using the processes, the child learns how to learn.

A child cannot be expected to learn all there is to know about science. It is the school's responsibility to help each child acquire the skills and processes necessary to obtain information. Processes are learned by the child "doing," not by the teacher "telling."

The following processes are emphasized in the K-3 science curriculum. The processes appear in the suggested learning activities and in the performance objectives.

Observing. Observing is more than seeing. It involves the use of all the senses. Some basic ideas to remember when observing are:

1. Use as many senses as possible. Look, feel, taste, smell, listen, crush, shake, press, and lift. Classify observations by the sense used.
2. Observe likenesses and differences when comparing two or more objects and when observing objects undergoing change.
3. Quantify observations. The size or number of objects is usually important.
4. Distinguish between an observation and and inference. Observations must be limited to properties which can be detected with the senses. Inferences are assumptions.
5. Utilize instruments, such as a thermometer or an equal arm balance, to extend observations of the senses.

Classifying. Classifying gives order to a collection of objects or events. Classifying occurs in daily activities--words in a reading lesson;

foods by fruits or vegetables; organisms by plants or animals; rocks by color or hardness; and music by high or low pitch. In classifying objects, three questions are pertinent.

1. What properties of the objects may be used to classify them?

2. Is there more than one way to classify the set of objects?

3. Which classification is more useful?

The following ways to classify are arranged from easy to more difficult:

1. Group Inclusion. Place an object in a proper category. Recognize that an object has the property of the category in which it is placed, for example: if the category is furniture, a chair will be classified as furniture while a tricycle will not.

2. Dual Membership. Recognize that objects can and do have many properties and can be placed in more than one category; for example: a cow is a mammal, but is also a female.

3. Serial Ordering. Order (seriate) objects into a sequence. Choose a property by which to order the objects, for example: length--shortest to longest; intensity or brightness--lightest to darkest; texture--smoothest to roughest

Communicating. Communicating involves recording and interpreting data to others in spoken and written form. In order to exchange ideas and information, precise language is important. First-hand experiences, direct observation, study prints, filmstrips, films, filmloops, tapes, and printed reference materials (books, dictionaries, and glossaries) are sources of information and ideas. The following are illustrative ways to record in science:

Labels for objects, pictures, or diagrams
Rebus sentences
Descriptions of observations
Experience charts
Records of observations
    Picture stories
    Data sheets
    Graphs (pictograph, bar, circle, or line graphs)
    Sequential directions for making investigations
    Specialized vocabulary.

Learning to read and interpret data is as important as learning to communicate and record. Hypotheses can be made and conclusions drawn from interpretations of recorded data. These reading skills are especially significant in science.

Measuring. Measuring is concerned with quantifying some property of an object or event. Properties often measured are length, mass, time, and temperature. Measuring is an integral part of science; both rough and precise measurements are required. The use of the metric system is increasing. Metric units are given in the list of materials and learning activities. The following sequence of measuring skills has relevance in elementary science:

1. Comparing the quantity of some common property of two objects, such as length, mass, or volume. The result is a "more than - less than" comparison.

2. Ordering (seriating) three or more objects by some common property, for example: smallest to largest; shortest to longest; thinnest to widest.

3. Measuring a property of an object by using an arbitrary non-standard unit; such as a hand or foot.

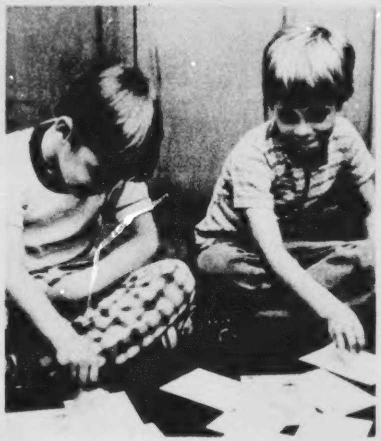
4. Measuring a property of an object by using some standard unit, such as foot, pound, metre, gram, or degrees.

5. Estimating measurements to assist in approximating a quantity.

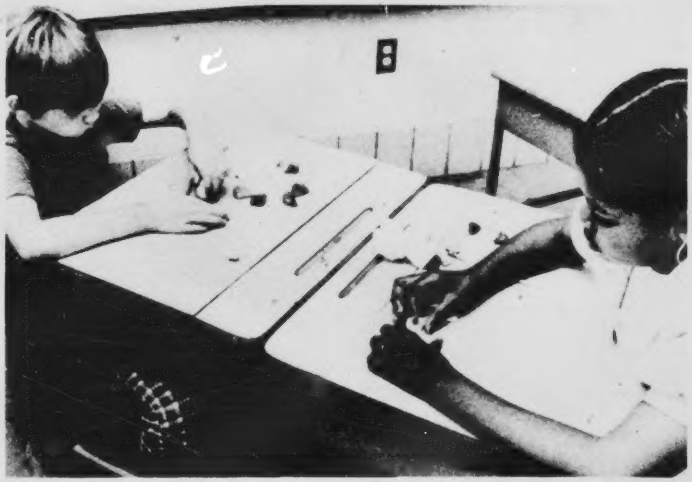
Inferring. Observations are made by using the senses. Inferences are ideas, explanations, or assumptions based on observations. Many different inferences may be made from a single observation. All inferences are not correct. Incorrect inferences are often the result of insufficient evidence. Some inferences can be tested more directly than others.

Predicting. Predictions are forecasts of future observations. Predictions are based on past observations of events that have a regularity in their pattern, such as sunrise and sunset. Observations, measurements, and past inferences provide evidence necessary for predicting. The more evidence a person has about the regularity of events, the more confidence he can place in his predictions. He begins to realize that nature is not capricious.

Identifying Variables. A variable is a part of an event which has influence on it. A variable may be an object, a condition, or a force. Children are able to identify variables long before they can control them. Identifying variables is often a matter of finding out what is different about two specific objects or events. "Why does one wagon coast farther than another?" (Possible variables: size of the wagons, material of the wheels, or the amount of friction.)



Mirrors,
streak plates,
sensory objects
spur-investigation into new areas of discovery



Classroom As a Laboratory

The science program today is laboratory oriented with an emphasis on observation, experimentation, and the search for order, regularity, and causality. Science learning is object centered. Children should use equipment and materials to explore various aspects of natural phenomena in a laboratory setting. This means that every classroom should have a variety of concrete materials. Since it is impossible for children to experience directly all aspects of science, there is a need for study prints, films, filmstrips, and books for reference. These reinforce and extend children's experiences with concrete materials.

An interest center devoted to science should be a vital and changing spot in every classroom. It is desirable for each classroom to have at least one aquarium, one terrarium, animals in cages, and plants. Manipulative materials, reference books, and media such as study prints, filmstrips, and cassettes are important components of the center. A display area is desirable for children to share their recorded findings. Display space is needed to give dignity to collections children bring to school.

Provision for storing materials must also be considered. A systematic organization is needed so children know where materials are housed. They should be taught how to distribute materials and how to clean up after using them. Chemicals should be placed in locked cupboards inaccessible to children.

Community As a Laboratory

Science learning should extend beyond the walls of the classroom. Too often children learn they "go outside to play and come back in to work." It is important to teach children the value of the outdoors as a place to learn. They spend many hours outside school. They must be helped to understand what they can learn from their own observations outdoors. Activities outdoors make learning more a part of the children's normal experiences and help them transfer what they learn in school to the real world setting.

Attention should be given in the local school to develop the school site as a resource for outdoor learning experiences. Even if the school grounds have concrete or blacktop, cracks in the pavement and small areas planted with flowers, shrubs, or trees can be utilized.

The science program should include a carefully planned and organized series of field trips for all children. Cincinnati is rich in community resources--Cincinnati Zoo, Cincinnati Nature Center, Museum of Natural History, Spring Grove Cemetery, Mt. Airy Arboretum, Krohn Conservatory, outdoor education centers, and parks. References to these and other specific community resources are given in the learning activities. Each trip should be an integral part of the science program. Specific objectives, plans for learning experiences, and evaluative activities are necessary.

Not only should the classroom extend into the community, the community should be brought into the classroom. Community resource people should be invited to contribute to children's understanding of the topic being studied and offer insights into career implications. References to specific kinds of resource people are given in the learning activities.

Science and Other Curriculum Areas

It is important that the teacher see the relationships among the various areas of the curriculum and interrelate them when feasible. As children work with objects and describe their properties, it is only natural that much descriptive oral language develops. It is suggested that the teacher use a language-experience approach in the science program. As children have many first-hand experiences, the teacher is encouraged to record words on charts. New words should be added to the chart throughout the year. These charts then serve as wordbooks for reading and creative writing. Many ideas for chart-making have been included in this guide.

Suggestions are also given for children to engage in reading activities. Functional reading is involved as they follow directions to carry out a learning activity from a text or a chart. Many activities require children to use reference books and other media to obtain information.

As children record findings from their observations, they begin to realize the need for communicating with others. Communication may take the form of pictures, written records, or graphs.

Frequently children need to use mathematics in science. They quantify data, read thermometers, graph the kind of weather, chart the growth of a plant, and read scales. The teacher needs to be aware of these opportunities so that children may apply mathematics learnings in a science context.

Science and Career Motivation

Many activities in the science curriculum are related to the Career Motivation Program. The general goals of career motivation are the following:

- To create an awareness and understanding of the world of work.
- To develop a positive attitude toward the world of work.
- To inspire an appreciation of and respect for all honest work.
- To create a desire to be a part of the world of work.

Learning activities marked with a # indicate those that are especially appropriate for career motivation. Some activities are extensions of previously marked career motivation activities and are not marked each time.

SCIENCE experiences inspire meaningful expression in LANGUAGE ARTS

Herbie was born this w
His parents are Cindy and
Guinea Pigs Herbie is small
looks just like his daddy
brown fur
teeth Herbie is
from his mother Cindy
Tony named the
Herbie We voted on
we all liked it best.

Role of the Teacher

The teacher's role is to guide children through many varied experiences and to motivate them to think. The role is that of a facilitator, rather than a dispenser of information. The focus is upon children as they investigate objects and events and interact with other children and the teacher. The teacher provides the physical and psychological environments that motivate and enable them to learn. The physical environment is described in "The Classroom As a Laboratory." The psychological environment is equally important. The teacher sets the tone for a comfortable, encouraging, and stimulating climate.

The teacher guides thinking through skillful questioning which will bring forth many kinds of responses--facts, generalizations, opinions, and values. It is relatively easy to ask questions which call for specific facts. These questions usually have only one correct answer and test a child's memory rather than his understanding. Questions which have more than one correct answer cause a child to think as he generalizes and uses concepts and processes. Usually, the teacher should accept responses without giving a value judgment so that the flow of ideas may be kept open.

The following questions may help teachers assess the psychological environment in their classrooms.

Am I accepting of children?
Do my questions cause children to think?
Do I accept their responses?
Do my responses encourage or discourage children?
Do I provide concrete experiences before developing abstract concepts?
Have I provided sufficient instruction?
Do I provide opportunities for children to explore and create on their own?
Do I help children relate school experiences to their real world?

Role of the Principal

As the instructional leader in the local school, the principal establishes an environment conducive to learning science. The principal should:

Recognize the importance of science experiences to children's lives.

Recognize the importance of science to a technological society.

Support the teacher in correlating science and other areas of the curriculum.

Ensure ample time in the schedule for teaching science.

Secure needed materials to provide a stimulating science program.

Encourage the use of manipulative materials and living organisms in the classroom.

Plan for use of school grounds for outdoor science experiences.

Organization of the Guide

The units in this curriculum guide are not grade-placed. They represent a four-year span, K-3. It is not expected that a teacher would develop all units with a given class of children. At the local school level, teachers are encouraged to plan longitudinally the primary child's science program. It is desirable that teachers include units from the Physical, Earth, and Life Science sections in each year's plan. This should ensure variety and balance in the child's science program.

The science curriculum, K-3, includes the three major strands of science: physical, earth, and life science. The topics in each strand are developed in the form of resource guides. Each is organized into the following components: Rationale, Background for the Teacher, Motivation for the Study, Concepts, Learning Activities, Performance Objectives, Bibliography and Mediography.

"Rationale" is based on child development. It points out some characteristics of young children. Their play activities, interests, and curiosity about the environment are considered in relation to the science topic.

"Background for the Teacher" consists of science information pertinent to the topic to be developed. The material chosen for the background is not all-inclusive. It is designed to serve as a "finger-tip" reference for the teacher. It should not be used directly with children. It is suggested the teacher carefully read this material before launching the topic with children.

"Motivation for the Study" contains a few ideas for some units to serve as an example. The initial approach will vary from classroom to classroom. Initiation may be planned by the teacher and children, occur spontaneously from interests of the children in the classroom, or evolve from a previously developed unit.

"Concepts" are the main science ideas related to the topic to be developed. They are listed within the units and a brief explanation or definition of the concept is included. The concepts serve as a guideline for the teacher. They are not to be memorized by the children.

A variety of "Learning Activities" has been included to develop the concepts. In most instances, the learning activities within each concept progress from easy to more difficult. Teachers should choose the activities appropriate for the children's needs, interests, abilities, and past experiences. Needed teaching materials or conditions are listed beside each activity. Suggested procedures for developing the activity are also given. The learning activities are suggestions. Teachers are free to provide other activities which will help children understand the concept. It is important to remember that children usually need to experience many learning activities to develop understanding of a concept. Otherwise children may be verbalizing without understanding.

"Performance Objectives" have been written to serve as illustrative examples of evaluation. They may be utilized as a pre-test measure. If the teacher sets up the conditions for a performance objective and children demonstrate they can do the requirements successfully, the teacher may omit the learning activities for that concept and move on to the next. If children do not show reasonable success, the teacher should then develop many learning experiences for a specific concept and utilize the performance objective as a post-test measure. By utilizing the performance objectives in this fashion, a child can enter at varying levels on the continuum of concept development. Unneeded repetition can be avoided and the child's instructional time can be planned for more profitably. Teachers may wish to develop their own set of performance objectives.

"Bibliography" contains suggestions for reference books for children. "Mediography" contains suggestions for materials, films, filmstrips, study prints, and tapes. These are to be used as references following the first-hand experiences suggested in the learning activities.

Evaluation

Evaluation is an integral part of the science program. It is a major tool in planning instruction, as well as determining its effectiveness. Evaluation must be persistent and continuous. Most assessment should be done informally. Teacher observation is a valuable instrument. As children interact with concrete materials, the teacher has a good opportunity to observe their behavior and assess the feedback.

Evaluation should be viewed broadly and include all aspects of child development. The teacher should assess: (1) Children's cognitive development. Can they describe the properties of a given object? (2) Children's development in the processes of science. Do they observe and record their data? (3) Children's attitudes. Do they turn off the faucets in order to conserve water? Do they remember not to cut across lawns? (4) Children's psychomotor skills. Are they developing fine muscles to pour liquids from one small container to another? Can they adjust the balance scale? Some aspects of the program are more difficult to measure than others.

The performance objectives are stated in functional language. They focus on precisely what learners can be expected to do; however, the possession of science knowledge and the processes of science do not guarantee a change in children's behavior.

Time Allocation

The Ohio State minimum standards require that 4/5 of the school week be devoted to the basic subjects--reading, language, mathematics, social studies, science, and health. The amount of time allocated to each of these will vary from school to school. The following weekly time allotments are given to ensure that children receive the minimum minutes of science instruction.

Grades 1, 2 - Science and Health, 60 minutes per week.
Grade 3 - Science and Health, 80 minutes per week.

PHYSICAL SCIENCE

PHYSICAL SCIENCE

The Physical Science section is built upon these major concepts--object, property, material, change, interaction, and system. These ideas are developed fully in the first unit, "All About Objects." They serve as a framework for concepts developed throughout the Physical, Earth, and Life Science sections. For example, the concept, property, is presented in the unit, "All About Objects." It occurs in new settings in the units, "Light" and "Sound," as the properties of each are explored. In the Earth Science section, properties of rocks, minerals, soil, air, water, and objects in the sky are developed. In the Life Science section, the properties of organisms, plants, and animals are called characteristics.

If children have not had previous experiences with the concepts, object and property, it is suggested that appropriate activities be provided them. Regardless of the children's grade level, development of these concepts will be a helpful foundation for all other topics in the science curriculum. It is recommended that the teacher read carefully the unit, "All About Objects," before developing other units.

There are topics which involve various forms of energy. Energy can exist in several forms: radiant energy, sound energy, heat energy, electrical energy, muscular and mechanical energy, chemical energy, and nuclear energy. Energy is never used up, but rather changes from one form to another.

Light is a form of radiant energy. The greatest source of light energy is the sun. Only a small amount of light energy radiated by the sun reaches Earth. Yet, this limited amount provides the entire Earth with energy. Man's attempts to provide light by artificial means are very meager in comparison with the light provided by the sun. This form of energy is developed in the unit, "Light."

Sound is a form of energy. Sound is produced by an object vibrating. A vibration is a back-and-forth motion. When an object vibrates, sound waves travel out in all directions. When the object moves forward, it pushes against molecules of air and presses them together (a compression). When the object moves backward, it leaves behind a space with few molecules that are spread apart (rarefaction). One compression and one rarefaction make one vibration. As the object vibrates, it produces compressions and rarefactions one after another. The ear picks up these waves and sends them through the ear to the brain where they are interpreted. When the vibrations stop, the sound stops. Sound energy is developed in the unit, "Sound."

Matter can be changed from one phase to another; such phase changes involve an exchange of energy--usually heat. Heat is that form of energy which is in transit due to temperature differences. All substances are composed of molecules in motion. Each molecule has kinetic energy because of this motion. The kinetic energy of a substance can be measured in two ways. Temperature is the measurement of the average amount of heat energy in a substance. The faster the molecules are moving, the hotter the temperature. Heat is the total amount of kinetic energy in a substance. Heat depends on the motion of the molecules and the number of molecules in the substance. Activities on heat energy are developed with the concept, change, in the "All About Objects" unit, page 10. The sun as a source of energy is developed in the unit, "Objects in the Sky," in the Earth Science section, page 236.

Electricity, a form of energy, can be transformed into any of the other forms of energy. Huge amounts of energy are needed and used in today's world. Energy must be released from where it is stored, transmitted to where it will be used, and then changed to the form in which it is needed. Dry cells are utilized in the activities on electricity. Energy is stored in the chemicals of the dry cell. The interaction of the chemicals releases this energy. It is transmitted along the conductors and then transformed by the use of appropriate devices into heat, light, motion, or sound. Activities on electricity are included with the concept, system, in the "All About Objects" unit, page 22.

Muscular and mechanical energy are introduced in the units, "Moving Objects and Forces" and "Simple Machines." Energy is needed to exert a force on an object, but energy itself is not a force. The sun's rays, muscles, springs, steam, electricity, moving air, and moving water are some sources that can produce forces. A force is a push or pull on an object. A force is necessary to make an object move or to stop an object that is moving.

An object moves in the same direction as the strongest force on it. The harder the force, the faster and longer the object will move. To slow down an object or make an object stop moving, the force must be exerted on the moving object in the opposite direction. Whether the force slows down the object or stops it depends on the amount of force exerted.

It is important for primary children to begin to develop an awareness of various forms of energy and forces exerted on objects in their physical world.

ALL ABOUT OBJECTS

Rationale

From infancy on, children have been intrigued by objects they see or hear in their environments. They reach out to touch, taste, or smell the objects. They like to play with objects to see what they can make them do.

Background for the Teacher

This unit lays the foundation upon which the entire curriculum is built. The major concepts, object, property, material, change, serial ordering, interaction, and system, are introduced.

An object refers to a piece of matter. As the children touch, observe, hear, and smell objects, they will understand and use the word, object, when they refer to a piece of matter.

Children describe objects by their color, size, shape, texture, or weight. These are called properties. A property refers to any characteristic or attribute of a piece of matter (object). The emphasis in the primary grades is on observable properties--those that can be identified by seeing, feeling, listening, or smelling. The properties, color, size, shape, texture, weight, and odor, are developed. Tasting objects is not emphasized. It may be done, but should always be under teacher supervision.

As children describe the properties of an object, they often tell its function. For example, when describing the properties of a crayon, a child may say, "It's long, red, and you draw with it." The teacher should accept the statement, but focus on the properties, long and red, rather than the function--"you draw with it." Through careful questioning, the teacher guides children to concentrate on the object's properties, not its use.

The teacher leads children to consider "what an object is made of"--its material. The concept of material involves more abstraction than the ideas of color, size, shape, texture, and weight. The children must concentrate on the properties of the material--wood, metal, or plastic. As they work with these materials, they begin to realize that there are different varieties of each material and that objects can be made of more than one material.

The form of an object can change but the material of the object remains the same. For example, a whole potato and a potato cut into pieces are the same material, but the appearance has changed. Liquid gelatin and frozen gelatin are the same material, but the shape has changed. Many varied activities on change have been included; some involve heat energy. Activities on change permeate the three strands, physical, earth, and life.

Serial ordering involves children arranging objects in sequential order according to certain properties, such as color, length, texture, or weight.

It is suggested that teachers of five- and six-year-olds develop the concepts, object, property, material, change, and serial ordering. The teacher should then select other units in the curriculum.

Seven- to nine-year-old children should be introduced to the concept, interaction. Objects interact when they do something to each other. Often a change is evidenced. It is suggested the teacher use questions similar to the following to develop the idea of interaction:

What were the objects?
Did they interact?
How do you know they interacted?
What is your evidence?

The interaction concept occurs in other units, such as interaction of rocks with liquids, interaction of water with various materials, the interaction of objects with gravity, or the interaction of objects in the sky.

System is the last concept introduced in this unit. A system is a whole made of parts that are related to each other. The parts are called objects and the relation stems from the interaction between the objects. For example, this curriculum guide could be referred to as a system. It is composed of pages, spiral binding, and printer's ink. People look at happenings from different points of view. One person may include the hand; another may include the reader as part of this system. Children will have different points of view as they identify objects in a system. It is important that the teacher listen carefully as children discuss their different views of systems so that their rationale may be understood.

Science becomes a personal thrill when your own breath makes the blue liquid change color

Concept	Performance Objectives
Object. An object refers to a piece of matter.	Given a set of objects, the child will be able to identify specific objects by name.
Property. A property is a characteristic or an attribute of an object. An object can be identified by describing its properties.	Given a set of objects, the child will be able to describe the objects by naming their properties.

Materials Needed	Learning Activities
common objects, such as pencil, crayon, chair, table, chalkboard eraser, or flag	Present the objects one at a time. Ask: Who can tell about this object? If the children describe the function of the object (pencil - you can write with it), accept the statement but focus on the properties by asking: How would you describe this object to someone who has never seen it?
chart paper marking pen	Begin a chart, "Properties of Objects," to record the language of the children as they describe the properties of the object.

Properties of Objects

red
long
yellow
sharp
little
heavy
rough
white
round
blue
rectangle
light
soft
smooth
black
bumpy
large
pointy
hard
big
square

Materials Needed	Learning Activities
chart paper marking pen	When the chart has approximately 15-25 words, read the property words. Ask: How could we group these words so that each group describes one property? (Group words under such headings as shown below.) Make a new chart. Continue to add other property words.

Properties of Objects

Color	Size	Shape	Texture	Weight	Odor
red	little	circle	rough	heavy	sweet
yellow	big	rectangle	soft	light	sour
white	large	square	smooth	medium	spicy
blue	tiny	triangle	hard		
black	wee	ellipse	bumpy		
	huge				

Concept	Performance Objectives
Property. (continued) A property is a characteristic or an attribute of an object. An object can be identified by describing its properties.	Given the properties of an object, the child will be able to identify the object by naming it.
	Given a set of objects, the child will be able to describe the objects by their properties.
	Given a set of objects, the child will be able to classify the objects into groups by a chosen property.
	Given a set of geometric shapes, the child will be able to identify two objects having identical properties.
	Given the picture or name of an object that can be eaten, the child will be able to describe its properties.

Materials Needed	Learning Activities
	Play games, such as "Riddle dee, Riddle dee, I dee dee. I see an object that you don't see. It's properties are _____, _____, _____." Child describes the properties. Children try to guess the object.
paper bags or plastic bags for each child work trays, handlens	Walk around the playground, school yard, or a nearby area. Ask: What objects do you see? Have children collect objects and put them in the bags. Collect as many as ten objects per child.
	When the children return to the room, have them spread their objects on their trays; have them use the handlens to examine each object closely. Ask them to describe the objects and discuss their properties.
	Have children choose one property and sort objects by that property. Discuss how various children sorted their objects. Add new property words to the "Properties of Objects" chart.
assortment of parquetry blocks in brown paper bags	Divide the children into small groups. Without looking in the bag, each child draws five blocks. Then he draws one block and puts one back into the bag. Object of the game: Match pairs alike in all properties (color, shape, and size). The first one to have all the blocks in matched pairs wins.
	Make up "property games" about objects you can eat. One child names a food, such as hamburger, apple, sandwich, popsicle, and cereal. Other children describe the properties of it.

Concept	Performance Objectives
Material. The material of an object is the stuff of which it is made.	Given a set of objects, the child will be able to classify objects according to the kinds of materials.
	Given a set of objects, the child will be able to identify the material of the objects.
	Given objects composed of more than one material, the child will be able to identify the materials of the object.
Change. The form of an object can change while its material remains the same.	Given a set of specific materials in different forms, the child will be able to identify the material of the object by matching the forms.

Materials Needed	Learning Activities
work trays objects made of a variety of materials: wood - bead, peg, ruler, clothespin, block, button metal - paper clip, key, paper fastener, toy, button plastic - button, fork, magnifier, tape holder, spoon, dish	Put a collection of five to seven objects on each work tray. Have children observe each object carefully, choose a property, and sort the objects on the tray by that property. (Compare and discuss the different ways children sorted the objects. Observe whether any sorted by material.) Have children sort the objects on the tray that are made of wood. Discuss those made of wood and those not made of wood. Ask: What are some of the other objects made of? Have children sort by another property. Note that the objects are made of materials--wood, metal, and plastic. Look around the room. Ask: What other objects in the room are made of these materials?
work trays objects composed of more than one material: pencil, clip clothespin, crayon with paper wrapper, paste jar, piece of paper with staple, marking pen	Have a collection of objects on each work tray. Ask children to observe each object carefully, choose an object, and describe it. Ask: What materials is it made of? How many materials is it made of? Have children check each object.
2 chocolate bars heat source ice cubes	Ask children to look at the chocolate bars and describe them. Place one in a warm area. After a while, have the children observe the change. Ask: How are the chocolate bars alike? (same material) Different? (The shape or appearance is different.) Use ice cubes. Follow the same procedure.
pencil pencil sharpener	Say: Look at the pencil. Describe it. Sharpen it. Have children compare the shavings to the pencil. Ask: How are the pencil and shavings alike? (same material) Different? (The shape or appearance is different.)

Concept	Performance Objectives
Change. (continued) The form of an object can change while its material remains the same.	Given a set of specific materials in different forms, the child will be able to identify the material of the object by matching the forms.
	Given specific conditions, the child will be able to state whether or not an object has changed form.
	Given specific conditions, the child will be able to predict if an object will change form.

Materials Needed	Learning Activities
small pieces of wood sandpaper work trays, handlens	Give each child a piece of wood and a piece of sandpaper. Have them change the piece of wood into wood dust. After sanding, have children look at the wood with the handlens and compare it to the piece that is left. Ask: How are the dust and the wood alike? (same material) Different? (The appearance is different.)
recipe for ice cream ingredients ice cream freezer	Make ice cream or sherbet in an ice cream freezer. Ask: What changes did you observe? Taste!
moth balls container	Let moth balls stand in an open container. Have children observe and record changes.
jars with lids variety of objects that fit these categories: Objects That Change Objects That Never Change	Have children put one kind of object in each jar with lid. Ask: What will happen to the object? Have children observe for a period of time, record periodically, and compare predictions with observations. Repeat the above experiment: with jars with no lids; by adding water to jars; by adding heat/cold; by adding light/dark. Objects to put in jars might include: 1. Food - cooked, raw, or preserved, liquid or solid. 2. Crystals, Salts, Powders - ice, salt, granulated sugar, brown sugar, sugar cubes, gelatin powder, baking powder, talcum powder or powdered sugar, soft drink powders or seltzer powders, starch, flour, moth balls or flakes, or paint. 3. Metals - nails, bolts, screws, steel wool, pieces of aluminum, copper, or brass. 4. Seeds - mustard, corn, lima or pinto beans, lentils, or rice. 5. Miscellaneous - crayon, paraffin, wood, plants, or candle.

Concept	Performance Objectives
Heat. Heat energy is a form of energy that interacts with an object. The result is a change in the object.	The child will be able to explain the effects of heat on an object.
	The child will be able to explain the effects of temperature on an object.

Materials Needed	Learning Activities
metal container, matches wood, saw or knife paper, scissors	Cut a piece of wood. Ask: How has it changed? Is it still wood? Cut a piece of paper. Ask: Is it still paper? How has it changed? Burn the wood and paper in a metal container. Ask: How have they changed? Note: The teacher should caution children against doing activities with matches without an adult present.
candle matches	Light a candle. Ask: What happens to the melting wax as it drips on a cool surface? (It changes back to a solid piece of wax again.)
matches, wood shavings aluminum foil containers	Place wood shavings in a used aluminum container; burn. Have children observe the change. Ask: What caused the change? Again, stress the need for an adult to be present.
eggs, pan hot plate, hot pad	Crack open a raw egg. Ask children to observe and describe. Hard boil an egg; crack it open. Ask: What has happened? What caused the change?
cake mix, utensils toaster oven/electric skillet	Mix a cake; bake it. Ask: What changes did you observe? What caused the change?
lemon juice, paste stick white paper heat source	Have children use a paste stick to make letters, numbers, or patterns with lemon juice on paper. Let all sheets dry. Warm the sheets over a heat source. Ask children to observe what happens. Ask: What caused the markings to appear?
ice cubes	Divide the class into groups. Give each group an ice cube. Note which group can make its ice cube melt first. Reverse. Note which group can keep its ice cube the longest.

Concept	Performance Objectives
Heat. (continued) Heat energy is a form of energy that interacts with an object. The result is a change in the object.	The child will be able to explain the effects of temperature on an object.
Serial Ordering. A group of objects can be arranged in sequence according to one or more properties.	Given a group of similar objects, the child will be able to order the objects according to one property.
Interaction. When objects interact, they do something to each other.	Given specific sets of objects, the child will be able to describe the changes that occurred as the objects interacted.
Evidence of Interaction. The observable effect of objects interacting is called evidence of interaction.	

Materials Needed	Learning Activities
heat source margarine 2 pans	Place equal-sized cubes of margarine in two pans. Heat one; leave the other at room temperature. Have children suggest why the one melted faster.
2 aquaria containing plants and animals	Place one aquarium in the sunlight. Place another away from the sun. Have children describe the changes in the growth of algae in each aquarium.
work trays variety of objects of varying lengths: pencils/crayons Cuisenaire rods/dowels variety of objects of varying sizes: round buttons/rocks shells, sandpaper pieces of paper--varying hues, textures	Have five to seven of the same objects on each child's tray. Say: Look at the objects; compare them. How are their properties alike? How are their properties different? (different color, different length) Demonstrate with a collection the order from shortest to longest. Ask: Where does each object belong? (This is called serial ordering.) Say: Serial order your objects by the property "length." Check each child's tray. Repeat procedure, using different objects. Have children serial order by different properties (color, texture, or size).
2 plastic tumblers with water food coloring	Say: Look at the tumbler with some water in it. Then put a few drops of food coloring in it. Ask: What happened? (The food coloring interacted with the water. It interacted because it changed the color of the water.) Ask: What is the evidence of interaction? (the color)
acorns, walnuts, pecans nutcracker or hammer	Have children look at the varieties of nuts. Ask them to describe the properties. Use the nutcracker to shell the nuts. Ask: What objects interacted? What is the evidence of interaction? Substitute peanuts in the shell.
soap flakes in a bowl water egg beater	Have children look at the soap flakes and describe their properties. Add some water; beat with the egg beater. Ask: What is the change? What objects interacted? What is the evidence of interaction?

Concept	Performance Objectives
Interaction. (continued) When objects interact, they do something to each other.	Given a set of specific pictures, the child will be able to describe the interaction suggested in the pictures.
Evidence of Interaction. (continued) The observable effect of objects interacting is called evidence of interaction.	
Interaction-at-a-Distance. When two objects that are not touching each other do something to each other, they interact.	Given objects, the child will be able to identify objects interacting at a distance.
	The child will be able to identify interaction-at-a-distance by using various senses.
	The child will be able to describe the pull of a magnet.
	The child will be able to distinguish between objects that do and do not interact with magnets.

Materials Needed	Learning Activities
sources of pictures	Have children cut pictures from newspapers and magazines that depict objects interacting. Ask them to identify interacting objects. Make a book or bulletin board from these.
magnet paper clips	Hold the magnet above the paper clips. Do not touch them. Move the magnet closer to the clips. Have children watch for evidence of interaction. (The magnet should attract the clips without touching them.) Ask: What objects interacted? What is the evidence? This is called interaction-at-a-distance.
	Capitalize on situations at school that illustrate interaction-at-a-distance; such as, aroma through hallways from popcorn popper; cookies baking in cafeteria; fresh rain outdoors; or cleaning solution in the restrooms. Turn electric lights on and off. Ask: What is the evidence of interaction between the electric lights and the objects in the room?
bar and circular magnets	Let children play with several pairs of strong magnets to experience the feeling of the pull of magnets.
collection of small objects: plastic, wood, and metal magnets	Let children test various materials with magnets to find which objects interact with magnets and which do not. Have children test to see which objects interact-at-a-distance with the magnets and make a chart classifying those that do and do not.
	Have children make a collection of magnets from workshop, kitchen, and school.

Concept	Performance Objectives
Interaction-at-a-Distance. (continued) When two objects that are not touching each other do something to each other, they interact.	Given appropriate materials, the child will be able to describe interaction-at-a-distance.
✓	Given an object of magnetic material, the child will be able to make an object into a temporary magnet.
	Given appropriate materials, the child will be able to demonstrate interaction-at-a-distance.

Materials Needed	Learning Activities
18" (45 cm) strip of strong, flexible cardboard picture wire magnet, tape	Bend the cardboard strip to form a circle; tape so ends meet but do not overlap. Make a loop of picture wire to fit inside the cardboard hoop; tape in place. Hold a strong magnet near the hoop. Ask: What interacted with the magnet? How do you know this is interaction-at-a-distance?
thumbtacks, pins, paper clips, nails cardboard, magnets sheet of glass thin board metal pie pan	Have children place several steel thumbtacks, pins, nails, and paper clips on a sheet of cardboard. Have them hold the cardboard in one hand and move a magnet across the bottom side of the cardboard. Ask: Did the objects interact with the magnet? Did they interact-at-a-distance? Vary experience by selecting some objects that will not interact. Or replace the cardboard with a piece of glass, a thin board, and/or a metal pie pan.
large steel needle or iron nail bar magnet	Let children make a temporary magnet by stroking a large steel needle or iron nail with the pole of a strong bar or horseshoe magnet. (Stroke about 50 times in one direction only.)
2 bar magnets with marked poles string	Have children bring the N pole of one magnet near the S pole of the other magnet. Ask: What happens? What do you feel? Is there interaction-at-a-distance? Tie a string around a bar magnet. Hang the magnet inside a box so it will not touch anything. Have children bring the S pole of the second magnet near the N pole of the hanging magnet. Ask: What happens? Is there interaction-at-a-distance? Have them repeat the same with N poles and discuss the interaction.

Concept	Performance Objectives
Interaction-at-a-Distance. (continued) When two objects that are not touching each other do something to each other, they interact.	Given a nail, wire, and dry cell, the child will be able to make an electromagnet and demonstrate its use.
System. A whole made of related parts called objects is a system. The relation may stem from the interaction between the parts or from a common function served by all the parts.	Given a system, the child will be able to identify the objects in the system. Given a system, the child will be able to identify the interaction of the objects in the system.

Materials Needed | Learning Activities

dry cells
insulated wire
iron nail, long steel needle, pencil, straight pins, paper clips

Wind 20 turns of wire onto one end of the nail. Start winding about 1 foot (30 cm) from the end of the wire. Fasten the short end of the wire to one terminal on the dry cell. Have children try to pick up pins with the nail. Now hold the other end of the wire so that it touches the other terminal. Have children try to pick up the pins again. Take the end of the wire away from the terminal. Ask: Is the nail still a magnet? Change the number of turns of wire. Have children make a chart.

Electromagnet Using One Dry Cell				
No. of Turns of Wire	10	20	30	40
No. of Pins Attracted				

Repeat using paper clips. Ask: Are the charts the same or different? Why?

Repeat using two dry cells to make a stronger magnet. Have pupils compare with the other chart.

Repeat replacing the nail with a steel needle or pencil and have pupils compare.

Note: See page 61 for interaction-at-a-distance with a telephone system.

pencil
pencil sharpener

Sharpen the pencil with the sharpener. Ask: What objects interacted? (pencil, sharpener, hand) How did they interact? (The hand held the pencil and the sharpener. The sharpener made a point on the pencil.) When objects interact, they make a system. Have pupils suggest a name for this system.

magnet
paper clips

Ask a child to make the magnet attract the paper clips and tell which objects interacted (magnet, paper clips, hand) and how. (The hand held the magnet. The magnet attracted the clips.) Have pupils suggest a name for this system.

Concept	Performance Objectives
System. (continued) A whole made of related parts called objects is a system. The relation may stem from the interaction between the parts or from a common function served by all the parts.	Given a system, the child will be able to identify the interaction of the objects in the system.
	The child will be able to locate a system and name the objects interacting in it.
	The child will be able to identify the objects in an electrical system.
	Given objects of an electrical system, the child will be able to demonstrate interaction.

Materials Needed	Learning Activities
chalkboard chalk	Write a word on the chalkboard. Ask: What objects are in this system? (chalk, chalkboard, hand) How did they interact. Have pupils suggest a good name for this system.
paper, pencil/crayons marking pen	Ask: What other systems can you find at home, at school, outdoors? Have children record the system on paper, name each object in the system, and give the system a name.
light bulbs in holders covered wire dry cell buzzer/bell	Fasten two pieces of covered wire to the terminals on the holder. Fasten the end of one wire to a terminal of a dry cell (open circuit). Fasten the end of the other wire to the other terminal of the dry cell (closed circuit). Ask: What are the objects in the system? What objects interacted? What is the evidence? Repeat using buzzer and bell.
	Discuss with children other systems which are familiar, such as school system, nervous system, water system, or system of government.

Bibliography - All About Objects

Bendick, Jeanne. Shapes. New York: Franklin Watts, Inc., 1968.

Freeman, Mae. Finding Out About Shapes. New York: McGraw-Hill Book Company, 1969.

Mediography - All About Objects

	Division of Resource Services A-V Number
Introducing Measuring: Comparing	8081
Long, Longer, Longest	3683
Measure Length - Think Metric	1697
Measure Volume - Think Metric	1701
Measure Weight - Think Metric	1703
Measuring Without a Ruler	3685
Most Important Person - Hearing	1310
Most Important Person - Seeing	1306
Most Important Person - Smelling	1307
Most Important Person - Tasting	1308
Most Important Person - The Five Senses	1305
Most Important Person - Touching	1309
Outset: Look About You	8020
Things Change: Solids, Liquids, and Gases	975

Division of Resource Services
A-V Number

No. 6660 Observing and Describing Shapes - Kit (Encyclopaedia Britannica)

Stepping Into Science Book Bags (Children's Press)

- Shapes - Sides, Curves, Corners (cassette and books)
- Things Are Alike and Different (cassette and books)
- Tools for Observing (cassette and books)

LIGHT

Rationale

Children have experienced light almost every moment of their lives. They are familiar with daylight and artificial light, but they seldom experience total darkness. Some children have observed a beam of light coming through a window and have been fascinated by the particles moving in it. Others have observed the colors of a rainbow in the sky or the "rainbow" in the water from a water sprinkler. Young children sometimes believe light comes out of their eyes and is reflected to them by objects.

Background for the Teacher

Earth receives light from two sources--directly from the sun and other stars and indirectly from the moon and other planets. The direct light from the sun is extremely important to people.

The greatest source of light energy is the sun. Only a small amount of light energy radiated by the sun reaches Earth. Yet, this limited amount provides the entire Earth with energy. Man's attempts to provide light by artificial means are very meager in comparison with the light provided by the sun.

Light is a form of radiant energy. Its energy radiates from a central point. Light travels in a straight line and takes about eight minutes to travel from the sun to Earth. It travels about 186,000 miles per second.

There are two ways by which people see an object. The object itself gives off light. Or the object does not give off light, but reflects light.

The sun, the stars, electric light bulbs, and a flame are examples of objects that give off their own light. Any material will give off light if it can be heated enough without undergoing a chemical change. For example, when a piece of metal is heated, it begins to give off visible light, a reddish glow; as it becomes hotter, the light becomes yellowish. If the fire is hot enough, the object becomes glowing white. A white-hot object is called incandescent. The sun and other stars are incandescent. Electric light bulbs which have a fine wire that is heated white-hot when electric current passes through it are also called incandescent.

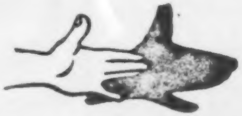
Most of the objects around people are seen by reflected light. Light falls upon the object and is reflected from the object to the eye of the observer.

Light energy can pass through transparent materials, such as clear plastic or glass. Translucent materials scatter light as light energy passes through them. Light energy cannot pass through opaque materials, such as wood or metal. The area behind the opaque object will be in shadow.

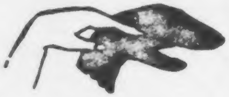
Various activities of casting shadow shapes are included. This is an old art, but the activities help to develop and sharpen important skills, such as communication skills--making shadow puppets; perceptual skills--guessing the shadow shape; creative skills--creating an animal with one's fingers or hand; fine motor skills--using fingers to make a shadow shape.

The following are a few "classic shapes" which may serve as starters.

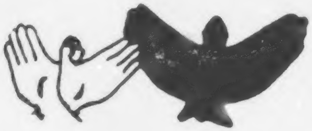
A dog. Place the hand straight out, with the thumb up to form the dog's ear. Hold all of the fingers together except the little finger. Move the little finger up and down to make the dog bark.



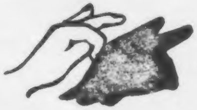
A little snake. The wrist and lower arm serve as the snake's body. Extend the palm down and hold the fingers together. The thumb is the movable mouth.



A bird. Cross the two thumbs; extend the hands, with the fingers closed on each hand. Flap the hands back and forth to make the bird fly.



A rabbit. Point the fingers straight up and the thumb toward you. Bend the thumb; place the index and middle fingers across it. Keep the ring and little fingers up to form the rabbit's ears.



The teacher may wish to begin the study of "Light" by introducing some of the exploratory shadow activities (pages 37, 39, and 41); then proceed with the activities for the concept, light source (page 30).

The concept of system occurs again in this unit. In this instance, the system referred to is a light system. A light system includes the following objects: a light source, the light from the source, an object seen, and the eyes. Light from the light source strikes an object; this causes an image to form so the eyes are able to see it.

Concept	Performance Objectives
Light Source. An object that produces light is a light source. Most light sources have enough energy to be very hot. A light source is necessary in order to see the source and objects.	Given a set of pictures, the child will be able to identify five light sources.
Light. Light is a form of radiant energy.	
	Given a specific set of pictures, the child will be able to classify light sources according to natural or man-made.
Properties of Light. Light has certain characteristics or attributes.	
Reflection. The light from a light source strikes an object and bounces off. This action enables the eyes to see the object.	The child will be able to infer the presence of light when he sees an object.

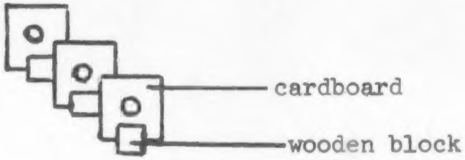
Materials Needed	Learning Activities
chart paper marking pen	Ask: Where do we get light? Discuss with children the sources of light. Record on a chart similar to the one below. Point out that the light from the sun is most important to people. Sources of Light sun electric light lightning bug candle stars matches gasoline lamp flashlight fluorescent light neon light
sources for pictures	#Have children observe sources recorded on the chart and classify sources of light according to natural or artificial. Have children cut out pictures of light sources; classify. Identify and discuss workers involved with man-made light sources.
reference materials: films, filmstrips, study prints, or books	Some children may be interested in reporting on light sources, such as the sun, a torch, or the electric light bulb. Have them find information concerning the work of Thomas Edison and Louis Latimer.
	Have children look around the room and identify some objects. Ask: Which of these objects are seen because they are light sources? (sun/daylight, electric lights) Which objects are seen by reflected light?

Concept	Performance Objectives
Reflection. (continued) The light from a light source strikes an object and bounces off. This action enables the eyes to see the object.	The child will be able to infer the presence of light when he sees an object.
Intensity. How bright an object is.	Given several light sources, the child will be able to compare the intensity.

Materials Needed	Learning Activities
for each child: white index card or piece of paper (to fit in bottom of bag) crayons heavy paper bag (large enough for child to look into) flashlight	Have children divide the card into fourths. Leave one fourth white; color each remaining fourth a different color. Place the card in the bottom of the bag with the crayoned side up. Say: Hold the bag to your face. What do you observe? (No light source, no color can be seen.) With the index card still in the bag, ask them to put a flashlight into the bag and hold the bag to their faces. Ask: What do you observe? (Colors can be seen.) Turn off the flashlight. Ask: What do you observe? (No colors can be seen.) Ask them to keep the card in the bag; hold the bag to their faces and move it away slowly. Ask: How do the colors appear?
	Ask: What is the light source? (the flashlight) Why couldn't we see the colors when we didn't use the flashlight? Encourage responses, such as: The bag and the card are not light sources. They don't give off light of their own. You need a light source to see objects.
	Ask: How can light change objects? Recall experiences children have had, such as: the flashlight in the bag; seeds planted and put in a light place and a dark place; and play in the sun for a long time.
various types of light bulbs: Christmas tree bulb, fluorescent bulb, night light bulb, heat lamp, or bulbs of varying intensity	Guide discussion with questions similar to the following: What kinds of light have you seen? What kinds of bulbs can you find at school?
	Have children describe the light given off by the various sized bulbs. Ask: What sources are brighter? Dimmer? Demonstrate the intensity of a three-way bulb. Have children describe each power and compare.
	#Ask: How do people regulate the intensity of light; for example, dimmers in theaters and dining rooms; lights on automobiles - parking lights, driving lights, and bright lights? What workers are involved?

Concept	Performance Objectives
Transmission. Light travels in a straight line.	Given appropriate materials, the child will be able to demonstrate the path of light.
Material. The material of an object is the stuff of which it is made. Light energy can pass through certain materials. Transparent Material. Light can pass through. Objects can be seen clearly through it. Translucent Material. This scatters light that passes through it. Opaque Material. Light cannot pass through it.	Given a set of materials and a light source, the child will be able to classify materials as transparent, translucent, and opaque.

<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td>pocket mirrors
light source</td><td>Let children work with the mirror and a light source. Ask: What do you observe about the direction of light? How does light come into a dark hallway at home or at school? Have them draw or describe how the light looks. Open the door to a dark room (storage room) and discuss what happens to the light from the hall. (It is reflected into the room.)</td></tr>
<tr><td>for each group of children:
3 pieces of cardboard (same size)
3 wooden blocks
thumbtacks</td><td>Cut holes in the centers of the cardboard. Let the children tack the pieces of cardboard to the blocks. Have them line up the holes so that they can see through them. Ask: When you can see through all three holes, how are they lined up? (The children will be able to see through the three holes at once by the natural light in the room. When the holes are not lined up, they cannot see through three at once because the light they need in order to see does not turn the corners.)


</td></tr>
<tr><td>objects made of a variety of materials:
cheesecloth, burlap, felt, fur, wood, metal, plastic, glass, brick, paper, wax paper, paper towel, foil
tumbler of water
tumbler of milk
handlens
piece of acetate
flashlight</td><td>Darken the room and test whether light will pass through the various materials. Have children classify and list.

<table>
<tr><th>Light Passed Through</th><th>Some Light Passed Through</th><th>Light Did Not Pass Through</th></tr>
<tr><td></td><td></td><td></td></tr>
</table>

#Have children classify materials according to transparent, translucent, or opaque. Provide time throughout the day for children to use a flashlight to test objects in the room. Discuss the different kinds of windows found in schools, homes, and businesses. Have children interview a glazier.</td></tr>
</table>

Concept	Performance Objectives
Material. (continued) The material of an object is the stuff of which it is made. Light energy can pass through certain materials. Transparent Material. (continued) Light can pass through. Objects can be seen clearly through it. Translucent Material. (continued) This scatters light that passes through it. Opaque Material. (continued) Light cannot pass through it.	Given a set of transparent, translucent, and opaque materials, the child will be able to demonstrate that different amounts of light pass through different materials.
Shadow. A shadow is formed when an object is in the path of light.	Given appropriate materials, the child will be able to make shadows.

Materials Needed	Learning Activities
sweater or other piece of translucent clothing book flashlight clear plastic cup black or heavy paper bag metal cap	Turn on the flashlight. Put the light behind the page of a book. Have children record observation. Try several pages. Ask: Did light pass through each time? Turn on the flashlight; place your hand over the lighted end of the flashlight. Ask children to record observation. Have children work in pairs; ask one child to place the light behind his ear. Have children observe and record. Ask: Did the light pass through the hand? The ear? Place a sweater over the light. Shine the flashlight into the cup, into the metal lid, and under the dish. Have children record observations; classify materials as transparent, translucent, opaque; and add to the preceding chart.
collection of transparent materials, such as clear glass, clear plastic a few opaque objects flashlight	Have children hold the transparent materials on edge toward the flashlight. Ask: Is a shadow formed? Note: Some transparent materials are opaque if held on edge toward the flashlight, especially if the material is not too thin. A light shadow may form. The material may be transparent in the other direction, however.
	Note: The following activities are exploratory experiences in shadow-making. As children explore with shadows, they are experimenting with spatial relationships in simple ways. Some children may feel ill-at-ease when they try to make shadows in front of others.
sunny day common objects: stick puppets, doll, cut-out designs, lacy paper snowflake, ball, scarf, scissors, or yardstick umbrellas/parasols (various sizes--man's, woman's, child's; various materials--cloth, plastic, paper)	Take children to the playground. Let them choose various objects with which they would like to explore shadow-making. Discuss with children the kinds of shadows the different objects make. Encourage children to manipulate the umbrellas to make shadows. Ask: Which is the biggest umbrella shadow? The smallest? The roundest? The flattest? How is the umbrella shadow of the cloth umbrella different from the plastic? The paper?

Concept	Performance Objectives
Shadow. (continued) A shadow is formed when an object is in the path of light.	The child will be able to make shadows with parts of his body.
	Given a set of objects and a light source, the child will be able to demonstrate making a shadow.

Materials Needed	Learning Activities
playground, chalk sunny day	Let children choose a partner. While one partner casts his shadow, the other draws around it. Reverse procedure. Have children observe shadows.
playground sunny day	Have children play Shadow Tag. One child is "It." "It" tries to catch someone by touching his shadow with his foot, his hand, or his own shadow.
playground sunny day	Let children choose partners. Ask questions similar to the following: Can you make your shadow shake hands with your partner's hands? Can you make your shadow touch your partner's fingers? Can you stand so your shadow is in front of you? Can you make your shadow dance? Can you hide your shadow?
slide projector projection screen	Make the room semi-dark. Seat the children fairly close to the screen, between the projector and the screen. Ask them to hold up their hands in the light beam and observe the shadows of their hands.
variety of objects: ball, block of wood, toy truck, or pencil filmstrip projector 3-sided white cardboard screen	To make shadow shapes, use the filmstrip projector and a three-sided screen. Hold a variety of objects in the stream of light from the projector. Now try objects, such as transparent paper, glass objects, or clear plastic objects. Ask: Do these make good shadows? Why not? Ask children to try to project different letters of the alphabet on the screen (C, L, and I are easy ones) or easy words.
screen filmstrip projector	#Project a child's profile on the screen; ask children to identify the child.
filmstrip projector a large sheet of newsprint	#Place the paper on the wall. Have a child stand between the sheet of paper and the source of light. Trace around his shadow (profile silhouette). Ask: What people use this idea in their work?

Concept	Performance Objectives
Shadow. (continued) A shadow is formed when an object is in the path of light.	Given a set of objects and a light source, the child will be able to demonstrate making a shadow. Given a sunny day, the child will be able to predict lengths of shadows at specific times.
Color. Light may be separated into a pattern of colors by passing through a prism.	Given a set of materials, the child will be able to identify the colors.

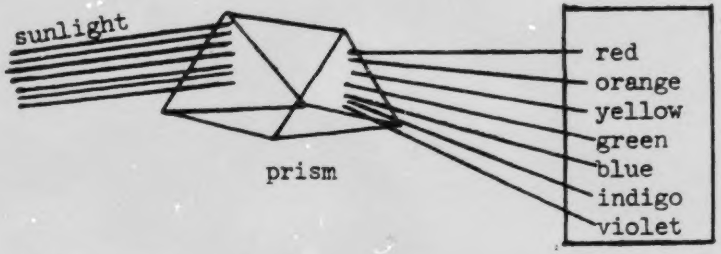
Materials Needed	Learning Activities
light source screen	Have pupils use their fingers to make shadow plays. (See suggestions, page 29.) Or make a play with a cast of shadow people. Have children project a finger or a thumb on the screen to represent actors for the shadow play.
light source doll	Ask: How long is the doll's shadow? Hold the light source high over the doll's shadow. Lower the light source. Hold it to one side of the doll. Keep changing the position of the light source. Ask children to observe the length of the doll's shadow each time.
pole chalk or ropes sunny day	Select a flag pole or tether ball pole. Ask pupils to draw around the shadow of the pole at three different times of the day--9:00, 12:00, 3:00--and measure the length of the shadow. Keep a record. Have a child measure the length of the shadow with the rope and compare lengths of rope used.
stick yardstick or ruler sunny day	Ask: Is a shadow the same length throughout the day? Have a child place a stick in the ground and measure the shadow. Leave the stick in place; have pupils measure the stick's shadow at different times during the day.
red, yellow, and blue paint white paper	Ask: What colors can you make from primary colors (red, yellow, and blue)? Have the children daub a bit of each color onto a white sheet of paper. Mix two of the colors together. Let the sheet dry. Say: Make as many combinations as you can (red-yellow, red-blue, yellow-blue, red-yellow-blue). Have children name the "new" colors.
soap, water container spools or bubble pipes	Let the children blow bubbles in the sunlight. Have children look at the bubbles. Ask: What do you observe? (Multiple colors are visible on the surface of the bubbles. This is due to soap or oil film breaking up the sunlight into its component colors.)

Concept	Performance Objectives
Color. (continued) Light may be separated into a pattern of colors by passing through a prism.	Given a prism, the child will be able to demonstrate that a beam of sunlight passes through the prism and is separated into colors of the spectrum.
Spectrum. When a beam of light passes through a prism, a band of color, ranging from violet to red, can be observed.	Given a spectrum, the child will be able to identify the colors of the spectrum in sequence.

Materials Needed	Learning Activities
prism	Place the prism in different parts of the room at different times during the day. Have children watch for the colors of the spectrum. Repeat for several days. Discuss findings. If a rainbow appears, take time out to observe.
colored cellophane or colored glass slide projector	Place several thicknesses of colored cellophane in the projector in place of slides in order to produce colored light. Darken the room; project the colored light on objects of various colors. Ask a child to describe how each looks and compare with the object as seen by the regular light in the classroom. Try different colored pieces of cellophane; have children describe and compare.
prism cardboard with slit, 1" x ½" (2.5 cm x 1 cm)	Cover the bottom half of a sunny window with the cardboard that has a slit. (The slit will allow only a small beam of sunlight to enter the room.) Hold the prism, base down, in the path of the beam of light. Ask: What do you observe? (The spectrum will appear on the floor or lower part of the wall.) Now hold the base of the prism up. Again ask: What do you observe this time? (The spectrum will appear on the ceiling.) Hold a piece of cardboard or paper in the path of the beam. Ask: Where is the spectrum this time? (The spectrum will appear on the cardboard.)
cardboard with slit, 1" x ½" (2.5 cm x 1 cm) a prism a sunny window white paper	Cover the bottom half of a window with the cardboard. Support a prism, base down, in the path of the beam. (The spectrum will appear on the floor or on the lower part of the wall facing the slit in the cardboard.) Hold the paper in the path of the beam. (The card or paper will serve as a screen on which to project the spectrum.) Ask: Can you name the spectrum colors? (red, orange, yellow, green, blue, indigo, violet) Try using an aquarium or a piece of cut glass as prisms.
films filmstrips books study prints	Provide reference materials and have children find out Isaac Newton's work with separation of colors by using a prism.

Concept	Performance Objectives
Spectrum. (continued) When a beam of light passes through a prism, a band of color, ranging from violet to red, can be observed.	Given pieces of colored paper, the child will be able to put in order the colors appearing in a spectrum.
Light System. A light source, the light from the light source, the object seen, and the eyes are objects in a light system.	The child will be able to identify the objects in a light system.
Communication. Lights convey messages.	The child will be able to identify three ways people use lights for safety.

Materials Needed	Learning Activities
sunny day prism white cardboard	When the sun's rays are coming through the window into the classroom, hold a prism in the path of the sunlight. Roll the prism until a rainbow is observed on the wall. Tape the white cardboard to the wall so that the spectrum will show up more clearly. Have children locate and identify the colors of the spectrum.



Ask children to look around to find a light system and name the objects in the light system. For example: System Plant (the object seen), sunlight (light source), the light from the sun, and eyes; System Chalkboard (the object seen), electric light (light source), the light from the bulbs, and eyes. Continue with other examples.

Have children draw pictures of light systems with one object missing. They may then quiz friends to see if the friend can name the objects in the light system and identify the missing object.

#Ask: How do people use lights to convey messages? The following may serve as discussion starters:

hazard or emergency lights
safety lights on streets, highways, and in tunnels
lights on household appliances--stove, toaster, coffee maker
beacon on lighthouse to warn ships of land or treacherous areas
lights on airport runways and on signal towers
lights on high buildings to warn pilots.

Bibliography - Light

Bursell, Henry. Hand Shadows to Throw Upon a Wall. New York: Dover Publishing Company, 1967. (Pictures were originally drawn in 1858.)

Feravolo, Rocco V. Light, Junior Science Book Series. Champaign, Illinois: Garrard Press, 1961.

Kettlekamp, Larry. Shadows. New York: William Morrow and Company, 1957.

Polgreen, John and Cathleen. Sunlight and Shadows. Garden City, New York: Doubleday and Company, 1967.

Shay, Arthur. What Happens When You Turn on a Light?. Chicago: Reilly and Lee Company, 1972.

Simon, Seymour. Let's Try-It-Out: Light and Dark. New York: McGraw-Hill Book Company, 1970.

Mediography - Light

	Division of Resource Services A-V Number
Light, Heat, and Sound	6466
Sunlight: A First Film	1149
No. S002/C0390 Color Lookers (John R. Green Company)	

SOUND

Rationale

Children have experienced sound from their earliest years. Every child born with normal hearing has been receiving and interpreting messages by means of sound. Children seem to enjoy sounds. They learn to speak by imitating sounds. They are intrigued by instruments that make sound. Much of their time is spent making sounds--often by humming, singing, chanting, or by striking objects on different materials.

Background for the Teacher

Sound is an important part of our environment. People recognize many objects by the sounds they make. They use sound to communicate with others, to express themselves, and to serve as warnings. Individuals vary in their sensitivity toward sound. A sound pleasant to one person may be unpleasant to another.

Noise pollution has become a major problem in today's world. Sounds, such as the noise of jet aircraft, air hammers, or amplifiers for music, may be sources of discomfort or danger. Sounds that are too loud produce sensory overload and may cause permanent damage to the ear.

People think of sound as something they hear. Scientists define sound as a form of energy produced by vibrating objects. Vibrations are back and forth or up and down motions. Vibrations can be heard, seen, and felt. As objects vibrate, they make the surrounding air vibrate. The vibrations travel through the air and people hear these as sounds.

Sounds have different properties which enable people to distinguish one sound from another.

Pitch is a property of sound. Pitch is determined by how fast the object vibrates. When an object vibrates, it makes a certain number of vibrations per second (the frequency). When an object vibrates fast, it produces more vibrations per second and a higher pitch results.

Intensity, a property of sound, depends upon the amount of energy applied to an object to make it vibrate. The more energy it has, the louder the sound it produces. Young children often confust high and low with loud and soft. A variety of learning activities is needed to help them differentiate between the two.

Sound travels through solids, liquids, and gases. Air is the most important transmitter of sound as people communicate daily. Sound travels best through hard solids. Soft solids absorb sound waves and reduce the intensity of the sound reflected. People attempt to absorb sound in their environments by installing acoustical ceilings and carpeting and hanging draperies.

The concept of a sound system is developed in this unit. A sound system consists of a force (that causes a vibration), a vibrating object, the material through which the sound travels, and the sound receiver. The receiver may be the ear or a mechanical sensing device.

Tuning forks are used in many activities. The teacher should demonstrate to the children the correct way to strike them. Hold the fork by the handle only. If the fingers touch the tines, they will quickly stop vibrating. Strike the tines against a rubber heel or on the leg just above the knee cap. Striking tines against a hard object may damage them or cause them to break.

Concept	Performance Objectives
Variety of Sound. Sound can be made in different ways. There are many kinds of sounds.	The child will be able to identify certain sounds.
	Given a variety of sounds, the child will be able to identify the objects making the sounds.

Materials Needed	Learning Activities
	Ask the children to close their eyes and to tell how many sounds were heard. Have them identify those sounds they can make.
the book, Listening Walk (See page 68.)	Open the window and ask children to sit quietly and listen to outdoor sounds. Or take a listening walk. Have children stop from time to time to listen. Ask: What sounds do you hear? Read the book, Listening Walk, to the children.
tape, tape recorder	Take a tape recorder on a neighborhood "listening walk." Record sounds in the community. Play back and have children identify the sounds.
for each child: sheet of paper sheet of aluminum foil	Ask: How many ways can you make sounds with a piece of paper? List the various ways found. Examples: Let it fall to the floor. Hold by one corner and shake. Hold opposite corners and pull paper taut. (Be careful not to tear.) Crumple and then place on table; listen to sound as paper expands. Smooth out paper. Hold paper taut and blow on it. Tear.
large box variety of "sound" objects, such as drum, watch, whistle, triangle, bell	Play a "listening game." With a variety of objects in a large box, ask children to identify and describe the sounds made by each. Encourage responses, such as tinkling of bell, tapping of a drum, ticking of watch, shrill of whistle, ringing of triangle and bell. Have children take objects out of the box to confirm identification.
	Variation: Use large and small objects of the same kind, such as a large and small bell. Ask children to hide their eyes. Make a sound with each. Have children identify the object that made each sound; classify the sound-makers used; and arrange them in categories according to the kind of sound.

Concept	Performance Objectives
Variety of Sound. (continued) Sound can be made in different ways. There are many kinds of sounds.	The child will be able to state ways sounds are made.
Communication. Sounds convey messages.	The child will be able to describe how various sounds cause him to react.

Materials Needed	Learning Activities
objects that make sounds of very short duration: marble, pencil, drum objects that continue to make sounds, even after the application of energy is stopped: guitar, bell, chimes objects that make sounds only as long as energy is being applied: horn, whistle, harmonica, stick, sheet of paper	Ask children to close their eyes. Using some of the objects, make sounds one at a time. Ask: What object made the sound? Have children describe the sound. Make a list of words children use to describe sounds.

Words to Describe Sound

ringing	scratching	low
ticking	screeching	deep
clicking	humming	high
ripping	roaring	loud
tapping	thumping	soft
rattling	hissing	

Materials Needed	Learning Activities
	#When a class of older children visit factories, ask them to record on tape the sounds of the various kinds of machinery they see and hear. Have them play it back for the primary children at school.
a record about "sounds"	Have children listen to a record about sounds. Ask: What are the meanings of certain sounds? What messages do they convey? What do you do when you hear these sounds? The following are suggested as discussion starters: a baby crying a dog barking people shouting a siren the fire bell ringing an alarm clock ringing a teakettle whistling a train whistle a horn honking a dog whining a policeman's whistle a referee's whistle
	Play a record. Let children respond to music by listening, dancing, or drawing pictures to illustrate the mood of the music.
	Have children imitate voices that indicate moods--happiness, anger, or sorrow.

Concept	Performance Objectives
Communication. (continued) Sounds convey messages.	The child will be able to describe how various sounds cause him to react. The child will be able to describe his feelings about certain sounds.
Sound. A form of energy that is caused by an object vibrating (moving back and forth quickly). When the vibrations stop, the sound stops.	Given appropriate materials, the child will be able to demonstrate that sound is produced by a vibrating object.
Vibration. A back and forth or an up and down motion.	

Materials Needed	Learning Activities
tape tape recorder	A group of children may be interested in developing a series of sounds that tell a story. Record on tape and present to the rest of the class.
	Discuss with children sounds they find pleasant and unpleasant. The following may serve as discussion starters: the wail of a siren the popping of a balloon the ringing of the school bell a ring of the telephone amplified music the bursting of firecrackers a person screaming the whine of a dog the patter of raindrops the crying of a baby
sources for pictures paper for mounting	Have children find pictures that depict pleasant and unpleasant sounds. Have each child classify according to his personal reactions.
toy instruments	#Organize a band. Have children bring in or construct toy instruments--drums, whistles, bells, xylophone, gourds filled with seeds, sand blocks, rubber band harps, cymbals, triangles made of horseshoes, and tonettes. Have children make sounds with the instruments and identify how the sound was made. Have them analyze each instrument and classify as stringed, percussion, or wind. Ask: What people use musical instruments in their work?
drum triangle piano tambourine rhythm sticks tone block melody bells sand blocks	Using a collection of musical instruments similar to those listed, have children make a sound with each. Ask questions, such as: How many different musical instruments can you identify? What is the method of playing? #How was each sound made? What is the source of vibration? How does the musician change the pitch or intensity of the sound? #Lead children to find answers to the above questions by looking at the instrument, observing someone play it, asking people who know how to play it, or reading reference material. Invite a musician to come to the classroom and demonstrate the instrument he or she uses.

Concept	Performance Objectives
Properties of Sound. Sound has certain characteristics or attributes.	
Echo. When sound waves are reflected from objects, the sound is repeated.	The child will be able to demonstrate an echo.
Pitch. The highness or lowness of a sound. When an object vibrates fast, it produces more vibrations and a higher pitch results.	Given a set of "sound-makers," the child will be able to demonstrate that some sounds are high and some are low.

Materials Needed	Learning Activities
	Ask: Have you ever been to a place where you made a sound and the sound came back to you? Where were you? What was the sound like? How long did it take for the sound to come back? Did you hear the sound more than one time?
	Take children to a large empty hall. Ask a child to stand at one end and call, "Hello!" Ask: What do you hear coming back? ("Hello!") Go to the gym or auditorium when empty and repeat procedure.
piano	Play notes of high and low pitch. Make comparisons of "higher than" and "lower than." Have children sing a tone. Ask: Which was higher? Lower? Open the piano and let children observe the various strings. Play a lower note; a higher note. Ask: What do you observe?
2 rubber bands of different lengths	Pluck the rubber bands. Ask: Which band is vibrating rapidly? Which one is vibrating slowly? Which one has the high sound? The low sound?
empty soft drink bottles of various sizes	Have children blow into the empty bottles. Compare the sounds. Ask: What does the size of the bottle do to the pitch of the sound?
2 metal pans--1 large; 1 small string	Have a child hit the larger pan; then hit the smaller one. Ask: Which makes the higher sound? Why? (The larger pan has a lower pitch because it is larger.)
nails board	Drive several nails different distances into a board. Have a child tap the nails with a large nail to make them vibrate. Ask: What did you observe about the sounds? Which ones made the high sounds? The low sounds?

Concept	Performance Objectives
Pitch. (continued) The highness or lowness of a sound. When an object vibrates fast, it produces more vibrations and a higher pitch results.	Given appropriate materials, the child will be able to predict which has the higher pitch.
	Given appropriate objects, the child will be able to predict the order of pitch among the objects.
Intensity. The amount of energy applied to an object to make it vibrate. The more energy applied, the louder the sound produced.	Given a set of "sound-makers," the child will be able to demonstrate that some sounds are loud and some are soft.

Materials Needed	Learning Activities
desk ruler	Place a ruler over the edge of a desk. Let about three-fourths of the ruler extend over the edge. Hold the short end firmly to the desk or place a heavy book on it. Pull down the free end of the ruler; let go. Ask: What do you hear? What do you see? Now let half of the ruler extend beyond the desk. Pull down again and ask: What do you hear and see this time? Does the ruler move faster or slower than before? (The ruler vibrates faster and makes a higher sound when the shorter piece of the ruler is pulled down over the desk.)
marble or pencil	Have a child roll a marble or a pencil across the desk for about 39 inches (1 m). Then roll it about 6 inches (15 cm). Ask: Is there a difference? Was one sound longer? Have children make sounds that are longer and shorter, such as whistling or humming.
variety of sound-making objects	#Encourage children to set up a bell display using doorbells, dinner bells, door chimes, and cowbells. Have them examine each to determine why it makes a high or low sound. Discuss what materials they are made of; how large and how thick they are; and how this affects the kind of sound each bell made. Ask: Where and how are bells used in the world of work?
melody bells	Ask children to predict which notes on the bells are the highest; the lowest; and to tell why.
3 or 4 tuning forks of varying lengths	Ask: Which tuning fork do you predict has the highest pitch? The lowest? Why? Serial order the forks; test. Ask: How accurate was your prediction?
	#Invite a piano tuner to the classroom to demonstrate how he uses sound in his work.
tuning forks	Ask the children to hit the fork gently; then harder. Ask: Which sound is softer? Louder? Repeat.

Concept	Performance Objectives
Intensity. (continued) The amount of energy applied to an object to make it vibrate. The more energy applied, the louder the sound produced.	Given a set of "sound-makers," the child will be able to demonstrate that some sounds are loud and some are soft.
Transmission. Sound travels through materials. The greater the density of the material, the faster sound is conducted.	Given appropriate materials, the child will be able to demonstrate that sound travels through each.

Materials Needed	Learning Activities
tuning forks strips of paper	Ask a child to hit the fork gently; then hold one end of it against the strip of paper. Have another child hit the fork harder; touch the paper. Ask: What happens to the paper? (It rattles more loudly.)
metal rulers	Hold the ruler so half of it is over the edge of a desk. Gently snap the free end. Ask: What do you hear? How does the ruler move back and forth? Snap the ruler harder. Ask: How is the sound different from before? (louder) How is the back and forth movement different? (It moves farther back and forth.)
combs piece of cardboard	Have children slowly scrape cardboard across the teeth of the combs. Ask: What do you hear? Have them scrape the cardboard faster across the teeth. Ask: How does the sound change as the teeth vibrate faster?
	Ask: What loud sounds do you like? Dislike? What soft sounds do you like? Dislike?
tape recorder magnetic tape	Record the children's voices on a tape recorder. Play back the tape so they may listen to each other and to themselves. (Our own voices never sound the same to us as they do to others because we hear our own voice mostly through a solid material--the bones of our neck and head.)
mailing tubes of various lengths cardboard tubes from paper towels	Have children talk, whisper, sing, and blow. Then have them talk, whisper, sing, and blow through various tubes. Ask: How does sound change through the tube? (The tubes direct sound.) Have children put one of their hands over one end of a tube and blow through the tube. Discuss what happens when they move their hand back and forth over the open end rapidly. (Different sounds are produced.)

Concept	Performance Objectives
Transmission. (continued) Sound travels through materials. The greater the density of the material, the faster sound is conducted.	Given appropriate materials, the child will be able to demonstrate that sound travels through each.
	Given appropriate materials, the child will be able to identify the material that carries sound to the ear.

Materials Needed	Learning Activities
silver spoon string tapping stick	Tie an end of the string around the waist of the spoon. Let the spoon dangle at one end of the string; hold the other end between two fingers. Ask a child to tap the spoon once and to listen for the chimes. Have him press the upper end of the string near the ear; tap very lightly. (It should sound like a great church bell.) Have a child hold the string away from his ear until the sound has almost faded away; then bring the string to his ear. Ask: What material does the sound go through to get to the ear?
	#Visit a church that has a bell system. Have someone explain how it works.
long waxed string wire 2 tin cans, open on one end with small hole in middle of opposite end	Make a telephone system. Tie the ends of the string to the tin cans. Have a child speak into one end while another child listens at the other end. Repeat the experiment using wire and other thicknesses of string to see which conducts best. Ask: What material does the sound go through to get to the ear?
	#Arrange to have Telezonia in the classroom, either through Resource Services or contact the school consultant at the Cincinnati Bell Telephone Company.
wrist watch table with wooden top	Hold a wrist watch in the air. Have children listen to the watch ticking. Ask: What does sound go through to get to the ear? Place the watch on one end of the table. Ask a child to place his ear to the other end of the table and compare sounds. Repeat with other children. Ask: What material does the sound go through to get to the ear?

Concept	Performance Objectives
Transmission. (continued) Sound travels through materials. The greater the density of the material, the faster sound is conducted.	Given appropriate materials, the child will be able to predict the material that is a better carrier of sound.
Sound System. Objects and forces that act together to make a sound are a sound system. A sound system consists of a force, a vibrating object, material through which the sound travels, and a receiver.	Given a sound system, the child will be able to identify the objects in the sound system.

Materials Needed	Learning Activities
a watch a sheet of paper a handkerchief cardboard tube cotton variety of hard and soft objects to fit inside tube	Roll the paper into a tube. Hold the watch at one end. Ask: Do you hear the watch ticking? What is inside the tube? (air) What does sound go through to get to the ear? How are sounds heard from distances? Open the paper tube; put a rolled-up handkerchief in the middle. Seal the tube. Repeat the test (holding the watch at one end). Ask: Now can you hear the ticking of the watch? What does the sound go through to get to the ear? (handkerchief) Which carries the sound better--air or the handkerchief? (A handkerchief muffles sound.) Use cotton. Ask: Do you think cotton conducts sound as well as air? Try other soft and hard things and have children tell through which materials sound seems to travel better. (Sound travels better through solids than through air.)
for each group: empty cardboard boxes rubber bands	Put rubber bands around the empty box. Have children pull the bands back and forth and then let go. Have children do the following: Name the objects in the sound system. (box, rubber bands, finger, ear) Tell what objects are making the sounds. (rubber bands) Tell which object caused the force. (fingers) Tell what the rubber band was doing when it was making a sound. (moving back and forth) Tell what they hear. (The band makes a sound when it vibrates.) Tell what happens when the band stops moving. (There is no sound when it stops vibrating.)
drum	Choose children to hit the top of the drum. Ask: What are the objects in the sound system? (drum, fingers, ear) What do you hear? What object is making the sound? (drum) Which object caused the force? (fingers/hand)

Concept	Performance Objectives
Sound System. (continued) Objects and forces that act together to make a sound are a sound system. A sound system consists of a force, a vibrating object, material through which the sound travels, and a receiver.	Given a sound system, the child will be able to identify the vibrating object in the sound system.
	Given a sound system, the child will be able to identify the force causing the vibration in the sound system.

Materials Needed	Learning Activities
drum	Have the children hit the drum again, but this time quickly put their fingertips on the top of the drum. Ask: What do you feel?
any of the following: dry cereal sand salt beans pieces of cork drum (or similar object)	Choose children to put one of the objects listed on the top of the drum and to hit the drum. Ask: What are the objects in this sound system? (drum, material used, hand, ear) What object made the sound? (material used) What object caused the force? (fingers/hand) What did the cereal (or sand, salt, beans or cork) do when a sound was made? (jumped up and down) What always happens to an object when it is making a sound? (It moves.) What is your evidence?
2 rubber bands of different lengths silver fork large cork lollipop stick	Ask children to hold one end of the rubber band between their teeth and to gently pull the other end (not enough to break it). Have them pluck it. Ask them to name the objects in this sound system. Ask: What object makes the sound? Which objects caused the forces? What is your evidence? Have a child strike the fork (it sings) and touch the fork to his ear. Ask: What do you feel? (the vibration) Repeat with other children.
tuning fork cork cup of water	Have a child strike the tuning fork against the cork and place the tuning fork against his face. Ask: What do you feel? (The tuning fork is moving.) Have another child strike the tuning fork and touch the surface of a cup of water. Ask: What do you observe? What is your evidence that a force is acting? (The water is moving.)
sturdy boxes (cigar boxes without lids) various sized rubber bands	Stretch several various sized rubber bands around the box. Let children experiment with making sounds in this sound system.

Concept	Performance Objectives
Sound System. (continued) Objects and forces that act together to make a sound are a sound system. A sound system consists of a force, a vibrating object, material through which the sound travels, and a receiver.	Given a sound system, the child will be able to identify the force causing the vibration in the sound system.
Absorption of Sound. Some materials have the ability to reduce sound.	The child will be able to state three ways people try to reduce sound.
Regulation of Sound. People have made laws to control sound.	

Materials Needed	Learning Activities
	Ask: What vibrates when you make a sound? Have children hold their fingers on their throats and make a buzz like a bee. Ask: Can you feel the vibration from your own sound-maker? (A voice box or larynx is inside your throat. When you speak, your breath passes over the larynx and causes it to vibrate.) Can you name the objects in your sound system?
	#Discuss what people do to absorb sound. Have children survey the school, home, and immediate neighborhood to identify ways people try to reduce sound (acoustical tile, carpeting, draperies, and soundproofing in telephone booths and classrooms). Discuss the people who perform these jobs.
resource people books films filmstrips	#Have children find out about the laws that regulate sound in their community, such as hospital zones, honking of horns, the use of pneumatic drills during certain hours, or sonic booms.

Bibliography - Sound

Berger, Melvin and Frank Clark. *Science and Music, From Tom-Tom to Hi-Fi*. New York: McGraw-Hill Book Company, 1961.

Branley, Franklyn. *High Sounds, Low Sounds*. New York: Thomas Y. Crowell Company, 1967.

Brown, Margaret. *Country Noisy Book*. New York: Harper and Row Publishers, Inc., 1940.

Brown, Margaret. *Indoor Noisy Book*. New York: Harper and Row Publishers, Inc., 1942.

Freeman, Ira M. *All About Sound and Ultrasonics*. New York: Random House, 1961.

Kettelkamp, Larry. *Drums, Rattles, and Bells*. New York: William Morrow and Company, Inc., 1960.

Kettelkamp, Larry. *Flutes, Whistles, and Reeds*. New York: William Morrow and Company, Inc., 1962.

Pine, Tillie S. and Joseph Levine. *Sounds All Around*. New York: McGraw-Hill Book Company, 1958.

Podendorf, Illa. *Sounds All About*. Chicago: Children's Press, 1970.

Podendorf, Illa. *True Book of Sounds We Hear*. Chicago: Children's Press, 1971.

Showers, Paul. *Listening Walk*. New York: Thomas Y. Crowell Company, 1961.

Windle, Eric. *Sounds You Cannot Hear* New York: Prentice Hall, 1963.

Mediography - Sound

	Division of Resource Services A-V Number
Let's Find Out What Sound Is	10676
Light, Heat, and Sound	6466
Outset: Listen, There Are Sounds Around You	8018
Telezonia	2671

MOVING OBJECTS AND FORCES

Rationale

Children live in a world of moving objects. They have had many experiences involving forces long before they enter school. They have pushed and pulled many objects in their daily environment and have encountered objects moving at various speeds. Some have experienced being thrown forward while riding in an automobile. Others have felt the pain of friction burns during play.

Background for the Teacher

A force is a push or a pull. A force is necessary to make an object move or to stop an object that is moving. As children experience the activities, they may use words like drag, haul, roll, throw, or lift. The teacher should help them to connect these words with the words, "push and pull," related to the idea of force.

An object moves in the same direction as the strongest force on it. The harder the force, the faster and longer the object will move. To slow an object down or make it stop moving, the force must be exerted on the moving object in the opposite direction. Whether the force slows down the object or stops it, depends on the amount of force exerted.

Two things are involved in work--a push or a pull and the movement of the object pushed or pulled. Scientists say work is produced whenever a force makes an object move through a distance. (No matter how great a force is exerted on an object, if the object does not move, then no work has been done--scientifically speaking.) According to the scientist's definition, if a person holds a heavy package and stands still or sits, if he thinks or watches, a person is not working. This concept of work may be very new to primary children.

Friction is the resistance encountered when one object slides over the surface of another. The amount of friction depends upon the pressure of one object on the other. The heavier the object, the greater the pressure and the greater the friction. When two surfaces rub together, they both become warm--sometimes a little warmer; other times, very hot. This heat represents the energy used to overcome the friction. Wheels, rollers, ball bearings, or lubrication are ways to help reduce friction. Identification of evidences of friction in the child's daily life is emphasized. Harmful and helpful aspects of friction are also considered.

Once bodies are in motion, they tend to keep moving. Once bodies are at rest, they tend to remain motionless. This tendency of objects that are moving to keep moving and objects at rest to remain motionless is called inertia. This is Newton's First Law of Motion. It is not necessary for children to use the term, inertia.

The concepts and activities in this unit are related to the concepts and activities developed in the unit, "Simple Machines." The bibliography and mediography on page 100 serve both units--"Moving Objects and Forces" and "Simple Machines."

Concept	Performance Objectives
Force. A push or pull is needed to make an object move or stop moving.	The child will be able to describe how objects can be moved.
	Given a set of pictures, the child will be able to identify a push or a pull.
	Given appropriate materials, the child will be able to demonstrate a push and a pull.

Materials Needed	Learning Activities
box filled with heavy books	Fill a box with heavy books. Ask: How can we move this heavy box of books? Encourage responses, such as: slide the box or pull it with a rope, push it with a piece of wood, turn it end over end, lift it to carry it. Let the children try out their suggestions. Develop the idea of a push or pull. Discuss the following with the children. How can you make other objects move? How can you make objects stop moving?
sources for pictures	Have children find and cut out action pictures showing pushes and pulls. Analyze the action in each. Ask: How can you tell the difference between a push and a pull? (A push moves an object away from a person; a pull moves it toward a person.) Can you think of any other way to move an object? (There is no other way; however, children may suggest other ways.) Discuss push and pull in everyday activities. The following may serve as springboards for discussion. Let children participate in the actions. When you get up from a chair, do you push or pull yourself to a standing position? (The feet push against the floor; hands push against the chair.) When you put on a shoe, do you push or pull your shoe? Or both? When you raise or lower your zipper, do you push or pull your zipper? Or both?
spring-wound toy	#Wind up a spring toy. Ask: Does the toy move by a push or a pull? (The spring usually pushes against the wheels of the toy.) Visit a toy factory. Interview a person who makes toys with springs.

Concept	Performance Objectives
Force. (continued) A push or pull is needed to make an object move or stop moving.	Given a set of pictures of specific actions, the child will be able to predict whether the object will move toward or away from a push or pull.
	Given appropriate materials, the child will be able to demonstrate that a force is needed to change the speed of an object.
	Given appropriate materials, the child will be able to demonstrate that a force is needed to change the direction of the motion of an object.
	The child will be able to explain the importance of wearing seat belts.

Materials Needed

Learning Activities

chart paper
marking pen

#Ask the children to find objects outside of school that they can move. Ask: How do you move them? Record on a chart similar to the following.

Object	Object Used By	Push?	Pull?
wagon	farmer; boy; girl	X	X
knife cutting bread or meat	mother; baker; butcher; short order cook	X	
dog on leash	dog walker		X
stroller	older child; parent	X	X
tow truck	truck driver		X
wheelbarrow	gardener	X	
bulldozer	construction worker	X	
bird and worm in ground	bird		X

wheel toys, such as
wagon, tricycle, car,
truck

The following activities may be developed on the playground or in the gymnasium. Questions to stimulate discussion are:

How can we make these objects move? Discuss and let children try out the different ways. (Relate to push and pull.)
How can we make them move faster? Try out the suggestions.
How can we make them move slower? Try out the suggestions.
What happens to the wagon when we pull hard; when we pull gently? What is the difference in how far the object goes?

balls

#Ask: How many different ways can you make the balls move? (roll, toss, bounce, throw ball up/down; throw to the side) Who can throw the ball the farthest? What do you have to do to make the ball go far? What do baseball players and football players do to make the ball go a long distance?

toy truck
assorted blocks
or
wagon with blocks

Have a child stack the blocks on the truck until it is full. Tell him to move the truck quickly forward and then to stop the truck suddenly. Ask: What happens to the blocks? (They continue to slide forward.) Have him suddenly move the truck forward and tell what happened.

Concept	Performance Objectives
Force. (continued) A push or pull is needed to make an object move or stop moving.	The child will be able to explain the importance of wearing seat belts.
	The child will be able to demonstrate how to stop an object that is moving by applying a force.
Work. An object must be moved by a push or a pull in order for work to occur.	The child will be able to identify work by stating the object that moved and the force used.

Materials Needed	Learning Activities
toy wagon doll	Have a child sit a doll in a wagon and give the wagon a sudden pull. Ask: What happens to the wagon? What happens to the doll? Does the doll move at the same time as the wagon moves? Does the doll move in the same direction as the wagon moves? Why? How is this like your riding in a car? Why do you think it is important to wear seat belts? Have a child sit the doll in the wagon and move the wagon quickly. Then ask him to push suddenly against the wagon to stop it. Ask: What happens? What happens to the doll? Which stopped first, the wagon or the doll?
wheel toys balls	Ask: How do objects stop moving? Using the toys, try out the children's suggestions. Ask: What force stopped the object each time? Which direction did the force come from to stop the object? (Try moving and stopping the object until the children generalize the force must come from the opposite direction.) #Relate activities to baseball. Ask: What makes the ball move? Where does the player get the energy to make the ball move? How is the ball stopped? When does the player have to use greater force to stop the ball? Why does he wear a mitt to catch the ball? Invite a baseball or basketball player to visit the classroom. #Relate the above to racing. Ask: What makes the car move? Where does the energy come from to make the car move? How is the racing car stopped? When does the driver have to use greater force to stop the car? What other forces can you think of that make objects move?
kraft paper paints or colored chalk	#Have children make a mural illustrating pushes and pulls at home/at play/ at work.
	#Discuss with children their ideas about work. Ask: Do you ever work? What do you do when you work? Do your mother and daddy ever work at home? What do they do when they work?

Concept	Performance Objectives
Work. (continued) An object must be moved by a push or a pull in order for work to occur.	The child will be able to identify work by stating the object that moved and the force used.
Friction. Resistance produced by one object rubbing against another.	The child will be able to describe how wheels help move an object.
	The child will be able to identify the force, friction.

Materials Needed	Learning Activities
	Ask children to identify some examples of work in which an object is moved (sweeping, spading the garden, doing dishes, washing clothes, dusting, or raking the lawn).
	#Ask: What actions in games would a scientist call work? (kicking a ball, jumping a rope, playing four-square, playing jacks, swinging on the rings) Why? In discussing these, have children identify the object moving and the force (push or pull).
source for pictures	#Have children find pictures illustrating the scientist's definition of work. Ask them to identify the object and the force used.
balls, coins, cylinders	Have children compare the round shapes. Ask: How are they alike? Different? How do they roll?
objects, such as: balls coins discs cylinders blocks books desks	Choose several children to try to move the various objects. Ask: Which ones are easier to move? Why? Why do some objects move more easily than others? What shape are the objects that move more easily?
	Have children carry a stack of books and then put them in a wagon. Ask: Which way is easier? Why?
large cardboard box enough books to fill the box	Have a child fill the box with books. Ask other children to push it across the floor, one at a time. Ask: How did you have to push? (hard) Why? The bottom of the box rubbed against the floor and produced friction. Ask: What could we do to reduce the friction? (Put rollers under the box, or put the box on a wagon.) Why would rollers or wheels help?
	Have children push palms of hands together and rub them quickly against each other. Ask: What do you feel happening to your hands? Why do they feel warm? (Rubbing objects together produces heat.)

Concept	Performance Objectives
Friction. (continued) Resistance produced by one object rubbing against another.	The child will be able to identify the force, friction.
	Given appropriate materials, the child will be able to identify evidences of friction.
	The child will be able to identify results of friction.

Materials Needed	Learning Activities

for each group of
children:
piece of wood
sandpaper

#Have children rub the sandpaper against a piece of wood. Ask: What do you feel? (heat) How do you know there is friction when you rub the sandpaper and the wood together? (You can feel the heat produced.) How has the sandpaper changed? The wood changed? What caused these changes? What workers use sandpaper? (carpenter, rock polisher, vehicle body repairman, or manicurist)

Discuss with children if they have ever experienced the following:

a hole in the sole of their shoe
a hole in the knee of a pair of pants
a piece of carpet showing worn spots
a hole in their sock
a sweater worn at the elbow
a tire with a worn-off tread

#Ask questions similar to the following to guide the discussion:

How do you think the holes were made?
Why didn't the other parts wear away? Stand up and look at the place where you put most of your weight. Look at the heels of your shoes. What parts are beginning to wear away? (side or back of heel)
Have you ever felt an old tire and a new tire? Why are smooth tires on a car or bicycle unsafe? Discuss bike inspection for safe bikes, children's driving school, and safety lane for automobiles. Why do people buy new tires or have them recapped? Who does this work?
What do you know about friction that might give you a clue?
What materials rubbed together?

chart paper
marking pen

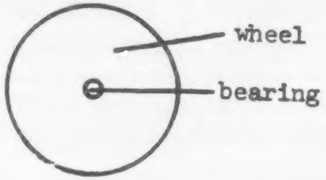
Make a chart similar to the one below. Ask: How can we take better care of some of these?

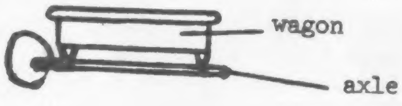
Materials That Evidence Wearing Away by Friction

shoe
tire
steps
elbows of sweater
knees of pants
rugs
fingers in gloves
hands from a rope burn

Concept	Performance Objectives
Friction. (continued) Resistance produced by one object rubbing against another.	The child will be able to identify results of friction.

Materials Needed	Learning Activities
	Ask: How is friction helpful? How safe would it be to drive a car if there were no friction? How is a moving car stopped by friction? (brakes) How does friction affect our using pencils? (Pencil is held by means of friction.) How is friction related to matches? (The heat of friction ignites the material in the head of the match.)
wagon with wheel and bearing	#Ask: What are some ways to reduce friction? (lubrication, ball bearings, wheels, or rollers) Take a wheel off a wagon and pose the following questions: Where is the axle? Where is the wheel? Why should the bearing be smooth? What happens if dirt gets in the bearing?
	Relate to automobiles and bicycles. Ask: What people inspect and repair these?





SIMPLE MACHINES

Rationale

Children use simple machines every day of their lives. They climb stairs (inclined plane), use scissors (levers) and pencil sharpeners (wedge and screw), raise and lower window shades (pulley), ride a bicycle (wheel), or watch their mothers use an egg beater (gear wheels). They are usually interested in using simple machines.

Background for the Teacher

Machines help people to do work more easily. In some instances, work can be done without machines; but it would require more time, more money, and more people to perform it.

A machine is a device that enables people to do work with the expenditure of less muscular energy. In some cases, the person controls the energy supplied by a motor or an engine. In other cases, the person supplies the energy, but for a longer time and with less force than would be possible otherwise.

The phrase, simple machine refers to a machine that is not complicated. Every machine, no matter how complicated, is a combination of a few simple types of machines.

There are two basic machines--the lever and the inclined plane. The pulley, wheel and axle, and gears are forms of the lever. The screw and wedge are forms of the inclined plane.

Inclined Plane. An inclined plane is a sloping surface. It is used to move objects to a higher level. Some examples of the inclined plane are the following: a gangplank leading to a ship, stairs, a road winding up a mountain, garages built with floors above ground-level, or a slanting board used to push an object to a higher level. The inclined plane enables people to do work gradually and raise an object more slowly but with less effort.

Wedge. The wedge is two inclined planes back-to-back. When a wedge is forced between two objects or into a material, it pushes the object or material apart. Picture a needle (wedge) pushed into the threads of a piece of cloth. If the needle is forced in all the way, it pushes the threads apart a distance equal to the thickness of the needle; but the force has been applied over a distance equal to the length of the needle. Knives, axes, the point of a nail, stakes driven into the ground, pins, and chisels are examples of wedges.

Screw. The screw is also an inclined plane. The thread of the screw forms an inclined plane going round and round the screw. The following are examples of screws: piano stools (with twirling seat), swivel chairs, propellers on airplanes and boats, wood screws (metal, but made to be put into wood), machine screws, and bolts and nuts.

Lever. The lever is probably the most common of the simple machines. A lever is a stiff bar, straight or bent, arranged to turn about some fixed point, called a fulcrum. The distance from the fulcrum to the object which is to be moved is called the "weight arm." The distance from the fulcrum to the place where the force is applied is called the "force arm." These names are provided for the teacher's use. Primary children are not expected to know these.

The various parts of the lever can be arranged in three ways. The force and the weight are on opposite sides of the fulcrum. People push down on the force arm to move the weight up (as in the case of a crowbar). The weight moves through a small distance; the place where the force is applied moves through a larger distance. Or the weight is between the fulcrum and the force and people pull up to move the weight up (as in the case of a wheelbarrow). The weight moves through a small distance; the place where the force is applied moves through a large distance. Or the force is between the fulcrum and the weight. A small movement of the force produces a large movement of the weight (as in the case of the elbow).

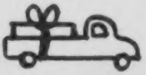
The Wheel and Axle. If a wheel is fastened to a rod in a way that turning the wheel turns the rod, it is called a wheel and axle. A small amount of force applied to turning the rim of the wheel causes a twisting force on the axle. Doorknobs, screwdrivers, automobile steering wheels, and grindstones are examples of wheels and axles. The wheel and axle is a development of the lever. Each spoke of a wheel may be considered as a lever attached to the axle. If a wheel is solid, it may be considered to have many spokes.

Gear Wheels. The gear is made up of wedge-shaped or tooth-shaped points. The toothed points act as wedges; the turning gear acts as a wheel.

Gear wheels or cogwheels are further developments of the wheel and axle. Gears are used to increase speed at the expense of force and vice versa. For example, when an automobile is in low gear, it moves forward more slowly but with more force than when it is in high gear. To prevent slipping between the wheels, teeth are often cut on the rims of the wheels. Gears are really toothed wheels. The teeth then mesh together and make slipping impossible. Gear wheels may be directly connected with each other (as in a watch) or at some distance apart and work together with a chain (as in a bicycle). Gears can go faster or slower depending upon the size of the gears turned.

Pulley. The pulley is used for pulling and hoisting. It is used to multiply force or change the direction of a pull. The simplest pulley consists of a wheel over which a cord is passed. If the free end of the rope of a flagpole is pulled down one foot, the flag is raised one foot. Flagpoles, some clotheslines, and window shade cords are examples of pulleys. Sometimes pulleys are arranged in combinations of movable and fixed pulleys. These are often referred to as block and tackle. People use these to handle and raise sails on sailing ships or to raise heavy weights, such as pianos, bank safes, and machinery.

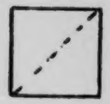
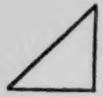
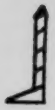
Concept	Performance Objectives
Inclined Plane. A ramp; a simple machine that is used to move objects up and down.	The child will be able to describe how a ramp (inclined plane) is used to move an object.
	The child will be able to predict the amount of force needed to move an object up an inclined plane.
	The child will be able to infer that a ramp makes work easier.

Materials Needed	Learning Activities
6' (2 m) long board 3' (1 m) long board wagon or wheel toy for loading objects books	#Have a child load the wagon with objects, such as books or rocks. Ask the child to place one end of each of the boards on the ground then prop the other end against a table or chair. Have him pull the loaded wagon up the short board. Ask: How does it feel? Now have him pull the wagon up the long board. Ask: How does it feel? (A long ramp makes the work easier.) Ask: Why are there ramps on the curbs in downtown Cincinnati?
toy truck 3' (1 m) long board heavy book shoe box string spring balance	Have a child put the book in the toy truck and tie the string around it.  Then ask the child to hook the spring balance through the string and lift to the height of the shoe box. Ask: How many pounds of force are needed? (The spring balance will show the pounds of force needed to lift the loaded truck.) Have a child slant the inclined plane from the floor to the top of the shoe box, then hook the spring balance to the front of the truck and pull it up the inclined plane. Ask: How many pounds of force are needed to pull the truck from the floor to the shoe box? What was the difference in the force needed this time than when you lifted the truck straight up?
18" (46 cm) x $\frac{1}{4}$" (5 mm) piece of plywood four bricks a small toy truck to hold a few rocks spring scale	Have children place bricks end to end and attach the spring scale to the front of the truck. Have a child pull the truck over the rough bricks, read the scale and record. Then have another child put the plywood over one brick, weigh, and record. Continue adding bricks to make a steeper incline. Have children compare weight at different levels and compare measurements. Ask: What do you observe? (More force is required to move the load up a steeper incline.)
2 heavy books spring scale long board	Have a child tie the books together and make a loop at the top. Then attach the hook of the scale through the string loop and lift the books with the scale. Have another child read and record. Have a child lean the long board against the desk to form the inclined plane and pull the books up the ramp with the spring scale. Ask another child to read, record, and compare the force used each way. Ask: Which way was easier to move the books?

Concept	Performance Objectives
Inclined Plane. (continued) A ramp; a simple machine that is used to move objects up and down.	The child will be able to explain how poeple use inclined planes in their work.
Wedge. A simple machine; two ramps (inclined planes) back-to-back; used to cut and split and push objects apart.	The child will be able to identify wedges in different objects.
	The child will be able to describe how a wedge splits an object.

Materials Needed	Learning Activities
	#Visit a nearby construction site when inclined planes are being utilized. (Workmen may be pushing wheelbarrows full of concrete or other materials from the ground to higher levels.)
	#Ask: How do people use inclined planes? Find out which workers frequently use inclined planes (furniture movers, construction workers, and delivery men).
knife axe nail pin chisel	Have children examine each of these carefully. Ask: How would you describe the shape of the sides; the ends of each?
nail hammer piece of thick wood blunt nail or rivet	#Have a child hammer the nail into the board. Try to hammer the blunt nail or rivet into the board. Ask: Which is easier? Why is the nail with a point easier? What does the nail do to the wood? How does this work for a carpenter?
pieces of apple or carrot	Have children observe each other as they bite into the food. Ask: How do the teeth act on the food?
knife bread or vegetable	Cut bread or a vegetable into parts. Show how the knife is a wedge.
pan of water toy boat	#Ask children to move the toy boat through the water and observe the action. (The prow of a boat is a wedge.) Ask: How is this like the nose of an airplane?

Concept	Performance Objectives
Screw. A simple machine; an inclined plane; the thread winds round and round to form an inclined plane.	The child will be able to identify the screw in different objects.
Lever. A simple machine; a stiff bar, straight or bent, arranged to turn around a fixed point; used to move an object.	Given appropriate material, the child will be able to demonstrate the function of a lever.

Materials Needed	Learning Activities
for each child: 6" (15 cm) square of paper scissors pencil crayons	Have children fold the pieces of paper diagonally and cut on the folded line. Have them observe that one side of the paper is a ramp (inclined plane). Have children color the slanted edge. Ask them to start winding, with the narrow end first, around the pencil. (The edge of the paper now looks like a screw.)   
screw piece of wood screwdriver	Place a screw in the piece of wood with a screwdriver. Ask: About how many turns will be made? What do you observe about the distance at each turn? (At each turn, the screw goes into the wood the distance between the threads.) When the screw is in the wood firmly, remove it. Ask children to observe it carefully. Have them estimate the number of times the thread goes around the screw.
pencil sharpener meat grinder nut cracker vice screw, nut boat propeller	Ask children to examine each object and describe it. Ask: How do these objects act like a screw? #Draw pictures and make a display of the machines discussed and workers who use each machine.
picture of winding stairway	Show a picture of a winding stairway. Discuss with the children how it could be considered a screw since it is actually an inclined plane that winds. Ask: Have any of you climbed the spiral staircase in the Statue of Liberty, Washington Monument, or a lighthouse? How do these compare with a screw?
empty box broomstick or crowbar books	Have a child put the books into the box. Ask the children to try to lift the box. Now have them try to lift the box using a lever. Have children compare lifting the box with the lever and without the lever. Ask: Which was easier? (with the lever)

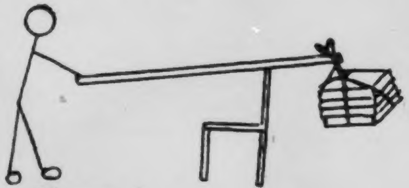
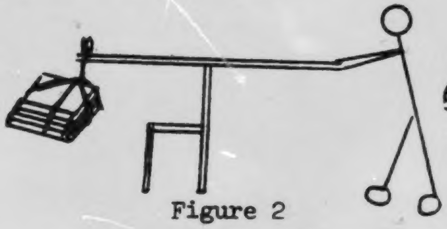
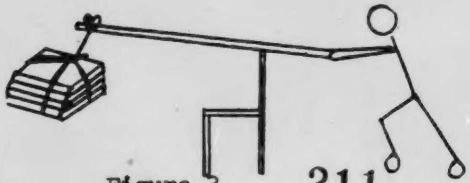
202

203

Concept	Performance Objectives
Lever. (continued) A simple machine; a stiff bar, straight or bent, arranged to turn around a fixed point; used to move an object.	Given appropriate material, the child will be able to demonstrate the function of a lever.
	The child will be able to infer that the closer an object is to the fulcrum of a lever, the less force is needed to balance the object.

Materials Needed	Learning Activities
3 large books wood or metal bookend strong stick of wood	Tie the books together with the string, leaving a loop at the top. Have a child lift the books with one finger. Ask: Is it easy to pick them up this way? Have him put the books down. Set the bookend beside them and place the stick across the bookend and into the loop on the books. Have the same child use just one finger to press down on the other end of the stick. Ask: Do you have to use as much force with the lever as you did without it? Experiment with positioning the fulcrum (bookend) farther away from the weight (books). Ask: Is it possible to lift the books higher than before?
can of paint screwdriver	Lift the top off the can of paint. Ask: What load is being lifted by the lever? Where is the force? The fulcrum?
rocking board or seesaw	You may wish to borrow the rocking board from the kindergarten classroom or visit a playground that has a seesaw. Show the children the center of the seesaw where the board turns or pivots, the fulcrum. (A seesaw is a lever.) Have two children get on and try to make the seesaw balance. (The children should move their positions on the seesaw. A lighter weight must be a greater distance from the fulcrum in order to balance a heavier weight.)
equal arm balance paper clips objects to weigh	Place one object in one pan of the balance. Place enough paper clips in the other pan to balance the object. Discuss how the balance is like the seesaw. After one object has been balanced, ask a child to take out some of the paper clips. Ask: What happens? (The balance moves up on the side with the paper clips.) How can we balance the lever without adding more paper clips? Relate to how the seesaw was balanced. Ask: What distance is the pan with the heavier weight from the fulcrum? What distance from the fulcrum is the pan on the other side?
	#Ask: Who uses a balance or scale in their work? (grocer, pharmacist, butcher, candy store clerk, and clerks in some yarn shops)

Concept	Performance Objectives
Lever. (continued) A simple machine; a stiff bar, straight or bent, arranged to turn around a fixed point; used to move an object.	The child will be able to infer that to push farther, it is necessary to push harder.

Materials Needed	Listening Activities
large box books short stick long stick	Have a child fill a box with books and try to lift the box with the short stick; the long stick. Ask: Which lever is easier? (the longer one) Have a child try pushing down at different points on the long lever. Ask: Is it easier to lift the box when you push near or far from the box? Do you have to push more or less when you use the long lever than when you use the short lever? (more)
6' (2 m) board brick	Have a child place the board over a brick. Let the children try to lift heavy objects--many books, large blocks, another child, or the teacher.
equal arm balance cork paper clips	Have a child put a cork on one side of the balance and a paper clip on the other. Ask: What happens? Add more paper clips. Ask: How many paper clips are needed to level the balance with the cork? Move the heavier object closer to the fulcrum in order to level the balance. Ask: What happens? (By moving the heavier weight toward the fulcrum, it will balance.)
hammer block of wood with nail in it	With the hammer, pull the nail out of the block of wood. Ask: Where is the load? The force? The fulcrum? (This lever has curved claws for pulling out nails. Nails are not heavy, but much force is needed to pull them out of the wood.)
4 or 5 books cord broomstick chair	Have a child tie four or five heavy books together with cord and try to lift the books with one finger, one hand, both hands. Fasten the pile of books to one end of the broom handle. Put the broom handle over the back of a chair. Most of the broom handle should be on the front of the chair. Have a child use a finger to press down on the handle. (Figure 1). Let several children try. Move the chair nearer to the child (Figure 2) and discuss what happens? Move the chair to the middle of the broom handle (Figure 3) and discuss the difference.  Figure 1  Figure 2  Figure 3

Concept	Performance Objectives
Wheel and Axle. A simple machine. The wheel is fastened to a rod (axle) in such a way that the wheel turns the rod.	
Gear. A simple machine. The tooth-shaped points of the wheel are wedge-shaped. The teeth mesh together with the teeth on other gears and make slipping impossible.	Given a set of common objects, the child will be able to identify gears.
	Given appropriate materials, the child will be able to demonstrate the function of a gear.
	The child will be able to explain what happens when a larger gear turns a smaller gear.

Materials Needed	Learning Activities
pictures or models of pinwheel, ferris wheel, windmill, waterwheel circular electric fan	Let the children try turning these and/or discuss how they turn. Ask: How are these wheels alike? Different? Where are the axles? What force moves each wheel?
construction set or Tinker Toys	#Have a child make a wheel and axle and try to move them. Ask: What other objects are similar? (doorknob, turntable on record player, steering wheel of car, bicycle, pinwheel, grocery cart, truck, or baby stroller)
egg beater, hand drill old watch/old clock bicycle	Observe the objects. Ask: Where are the gears on each of the objects? How would you describe a gear? How do you think gears make word easier?
3 bottle caps with serrated edges piece of wood	With a nail and hammer, make a hole in the center of each cap. Flatten out the caps as much as possible. Put two caps on the piece of wood so that the edges mesh together. Fasten to the wood with tacks; the caps should turn easily.
	Ask a child to turn one of the caps and observe the direction in which the other cap turns. Now ask another child to turn the cap at the end in the same direction and tell in which direction each cap turns. Ask a third child to turn the cap at the end in the other direction. (Gears can change the direction of a force.)
hand drill hand egg beater	Have a child turn the larger gear. Ask: What happens to the smaller gear? (It turns also.) Which gear is turning faster? (The smaller gear turns at a more rapid rate than the larger gear.) Have another child turn the smaller gear and tell how fast the larger gear turns? (The larger gear turns more slowly than the smaller gear.)

Concept	Performance Objectives
Gear. (continued) A simple machine. The tooth-shaped points of the wheel are wedge-shaped. The teeth mesh together with the teeth on other gears and make slipping impossible.	The child will be able to demonstrate what happens to a smaller gear when it is turned by a larger gear.
Pulley. A simple machine used for pulling and hoisting. The pulley is used to multiply force or change the direction of the pull.	The child will be able to describe how a pulley raises an object.

Materials Needed	Learning Activities
2-wheel bicycle	Choose a child to turn the bicycle upside-down on the floor and examine the gears and the chain. Then ask him to turn the pedals. Ask: What happens? (When the pedals move, they turn a larger gear--a sprocket wheel.) Choose a child to turn the pedals until the front sprocket wheel makes one full turn and observe the rear wheel at the same time. Ask: How many times does the rear wheel go around. (usually two or three times)
hand egg beater	#Let children explore the beater. Ask: What happens when you turn the handle of the beater? (The blades go around several times for one full turn of the beater.) How does the beater work? (The large gear on the handle turns two small gears connected to the blades.) Have them turn the handle slowly. Ask: How do the blades go? (fast) Visit the school lunchroom and ask the cook to demonstrate the beaters used.
hand drill	#Let children explore the drill. Ask: What happens when you turn the handle of the drill? (The drill bit turns many times.) How does the drill work? (The large gear on the handle turns the small gear which turns the bit.) What happens when you turn the handle slowly? Invite the custodian or art teacher to demonstrate how they use a drill. #Relate to the dentist using a drill on teeth. If possible, invite or visit a dentist. Ask the dentist to explain how drills are used.
flag pole flag	#Take the children outside to the school's flag pole. Pull down on one end of the rope. Ask: What happens? (The other end and the flag go up the same distance the free end was pulled down.) Which direction did we pull? (down; the applied force) Which direction did the flag go? (up; the resultant force) How could the flag be raised if there were no pulleys? What other objects are raised to high places by using pulleys? (painters' scaffold) #Observe the school guards and/or custodian raising the flag.

Concept	Performance Objectives
Pulley. (continued) A simple machine used for pulling and hoisting. The pulley is used to multiply force or change the direction of the pull.	Given appropriate materials, the child will be able to demonstrate the function of a pulley. The child will be able to infer that a pulley makes work easier.
Simple Machine. A device that enables people to do work with exerting less muscular force.	Given a specific set of objects, the child will be able to classify according to the type of simple machine.

Materials Needed	Learning Activities
window shades	#Demonstrate the use of the pulley by using the shades in the room.
pulley rope book spring balance scale	Place the rope over the pulley. Attached the book to the hook of the pulley. Tie one end of the rope to a fixture on the wall or on a stand. Attach the other end of the rope to the spring balance. Let the book rest on the floor or on a table. Have children lift the book. (This is a movable pulley.) Ask: How does it feel? (It should be easier than with a fixed pulley.)
broom handle, cut in half clothesline	Have two children stand facing each other. Ask each to hold one piece of the broomstick with both hands. Ask a third child to grasp the centers of the two sticks and try to pull the other two together. (They will be pulling in opposite directions. The third child should not be able to do it.) Now tie one end of the rope to one stick, lead it over and around the second stick. Ask the third child to pull on one end of the rope. (The child should be able to bring the two sticks together, no matter how hard the other two children attempt to keep them apart.) This combination of fixed and movable pulleys is referred to as a block and tackle.
common objects: wedge - chisel, pin, stake, knife, spatula, nail lever - can opener, crowbar, arm balance, nutcracker, wrench gear - egg beater, clock gears, hand drill	Ask children to bring in objects suggested and demonstrate their use. Let the other children identify which simple machine it is. Make a display and classify by categories. #Discuss which people use each simple machine in their occupations or leisure time activities. Ask children to make a list or draw pictures of all the simple machines they use in one day.

Bibliography - Moving Objects and Forces/Simple Machines

Adler, Irving and Ruth. Machines: The Reason Why Book. New York: John Day Company, Inc., 1965.

Darby, Gene. What Is a Simple Machine?. Westchester, Illinois: Benefic Press, 1961.

Olschewski, Alfred. Wheels Roll Over. Boston: Little, Brown and Company, 1962.

Podendorf, Illa. The True Book of Energy. Chicago: Children's Press, 1963.

Sharp, Elizabeth. Simple Machines and How They Work. Westminster, Maryland: Random House, 1959.

Ubell, Earl. The World of Push and Pull. New York: Atheneum Publishers, 1964.

Woodward, Hildegard. House on Grandfather's Hill. New York: Charles Scribner's Sons, 1961.

Mediography - Moving Objects and Forces/Simple Machines

	Division of Resource Services A-V Number
Finding Out About Simple Machines - Levers and Inclined Planes (Basic Primary Science, Group III)	5737
Let's Find Out About Friction (Science--Let's Find Out)	10677
Let's Look at Levers	284
Machines Do Work	2300
Simple Machines Help Us Work	6596

EARTH SCIENCE

EARTH SCIENCE

This section, Earth Science, emphasizes understandings about the planet Earth and the universe. It includes the disciplines geology, meteorology, and astronomy.

The Earth is composed of three parts: the solid, called the lithosphere; the liquid, called the hydrosphere; and the gaseous, called the atmosphere.

Lithosphere. The lithosphere (meaning rock sphere) is the solid part of Earth. It is made up of rocks with a covering of soil varying in depth. The surface of the lithosphere varies in appearance--rugged cliffs, mountains, and flat plains. This is due to the effects of running water, ice, and wind. As a result, there is a covering of soil and fine rock over most of the level areas. Coarser material and rocks are under this. The lithosphere has three layers: the crust (outer layer); mantle (middle); and core (inner).

The crust is of greatest concern to people. They are in contact with it daily and their lives depend upon its composition and their understanding of it. Rocks and soils with different properties and different ways of formation compose the crust of Earth. The geologic processes of weathering, erosion, volcanism, and the raising and lowering of land form the wide variety of rocks and soils in the crust.

In this section, the units, "Rocks and Minerals," "Soil," "Fossils and Dinosaurs," are all related to the lithosphere.

Hydrosphere. Together the oceans, lakes, rivers, streams, the water within Earth, and the water in the atmosphere compose the liquid part of Earth. This is often referred to as the hydrosphere (meaning sphere of water).

The greatest part of the water is contained within the oceans which cover approximately 3/4 of the entire surface of Earth. The liquid part does not exceed the solid in size or volume since the greatest depth of the ocean is approximately seven miles (a small fraction of the diameter of Earth).

The oceans are people's greatest source of water. Water evaporates, winds carry it, meet, and override colder masses of air; the water condenses and falls as rain, snow, sleet, or hail and forms on the ground as dew or frost. This cycle of water serves as an equalizer of climate.

People utilize food and other economic products from the water sources. They also use water for recreation and for commerce.

The units, "Water," "Air," and "Weather," are related to the study of the hydrosphere.

Atmosphere. The atmosphere or gaseous part of Earth act upon the solid part by helping to wear down the land and transport soil to other parts.

Living organisms are surrounded by air from birth to death. The vast "ocean" of air completely envelopes Earth. People live at the bottom of it.

The atmosphere is densest at Earth's surface. Scientists believe that the atmosphere extends to a height of hundreds of miles. The air is very thin at such heights.

The atmosphere is continuously changing. People observe this change in cloud formations, sunrise, sunset, haze, wind, rain, hail, snow, lightning, and thunder. This change involves the interaction of a tremendous amount of energy from the sun, the gravity of Earth, and the rotation and revolution of Earth.

The units, "Air," "Water," "Weather," and "The Solar System," develop concepts about the atmosphere.

Interaction of Forces. Forces are always at work in the universe to maintain balance. Wherever people observe, they find evidences of balance; however, they often take these for granted since they observe them only one day at a time. The force involved in evaporation is tremendous when one considers it takes place over the entire Earth and results in rain, snow, dew, frost, weathering, erosion, floods, and the like. The hurricane, tornado, and thunderstorm are thought to be caused by the lack of balance of forces stemming from the energy of the sun, the gravity of Earth, and movement. Some geologists believe that in maintaining balance these forces have caused the formation of mountains, continents, and oceans.

It is important for children to begin to develop an awareness that there is a balance in the universe. Nature is not capricious.

Use of books for reference can be triggered by real objects...

...or class discussions of things outside children's experience

ROCKS AND MINERALS

Rationale

Children are natural collectors. A look at the objects in a child's pockets or handbag will reveal prime examples of the collector's art and interest. To collect and to sort go hand-in-hand. Collecting and sorting are one way a child finds out about the world. The child begins to observe the properties of objects, the ways in which the objects are alike and different, and the characteristics of materials. He devises ways to sort, classify, and group and regroup according to his own standards.

Children show a great interest in rocks. When they bring rocks to school, their reasons for selecting a certain one might be:

> "I picked it up because it
> has a pretty color
> looks like a strawberry
> is good for hop-scotch
> looks like a foot
> has holes in it
> sparkles
> is smooth
> is sharp."

Background for the Teacher

Rocks are made up of one or more minerals. A mineral is a solid element or compound that is found naturally in Earth's crust. Minerals do not come from or are not made of living things. The properties of rocks depend mainly upon the materials of which they are composed.

The phrase, "collection of rocks," used in this course of study is not properly "rocks," but "minerals." The term "rocks" is used throughout the activities because young children usually do not differentiate between the two terms, "rocks" and "minerals." An activity (page 121) has been included to help children begin to develop an understanding of this concept, but primary children are not expected to make this distinction.

Little emphasis is placed upon children learning to name rocks or minerals. The names of some of the rocks and minerals may be introduced after the children have worked with the samples or if individual children evidence an interest. After children have had experiences with the samples, they can utilize reference books, filmstrips, films, and study prints to find additional information.

Minerals have various properties, such as color, streak color, luster, hardness, reaction to acids, cleavage, fracture, specific gravity, and crystalline formation.

Usually, many tests must be applied to rocks and minerals before they can be identified. The following tests are developed in this unit.

Color. The color results from the colors of the materials of which the rock is composed. It is important to look at a fresh surface, since the unweathered surface shows the true color.

Streak Color. Streaking is also used to test color. The sample is rubbed against a small piece of unglazed porcelain tile called a streak plate. When some of the mineral rubs off on the tile, a streak is made. Non-metallic minerals usually produce a light-colored or colorless streak. Metallic minerals often produce a dark streak that may be different from the original color of the mineral. Some minerals are soft enough to make a streak on paper. It is necessary to help children distinguish between a scratch and a streak.

Luster. Luster is the shine the mineral has when light strikes it. Words, such as dull, shiny, pearly, glassy, diamond-like, are often used to describe the property, luster.

Magnetic. Some minerals, such as lodestone or magnetite, are magnetic and will be attracted by a magnet.

Interaction. When objects do something to each other, they interact.

> Interaction with Water. When rocks interact with water, they may do the following: change color, dissolve, partially fall apart, sink, or float.
>
> Interaction with Vinegar. A few rocks with a calcium base, such as limestone, natural chalk, and calcite, contain a material called carbonate which fizzes when acid is put on it. Vinegar sometimes causes this effect. Marble will generally react to vinegar. Bubbles usually form and part or all of the sample may disappear.

Hardness. Rocks and minerals differ widely in hardness. It is helpful to know the hardness of a mineral in order to identify it. Certain minerals are used as standards of hardness and are measured on a ten-point scale.

The most commonly used scale of hardness is called Mohs' (mōz) scale of hardness. Mohs' scale has ten minerals, arranged from softest to hardest. Talc, one of the softest minerals, is 1 in the scale; diamond, the hardest known mineral, is 10.

Mohs' Scale of Hardness

Mohs' Number	Comparison Mineral	Field Scale
1	Talc	Pieces flake off with fingernail.
2	Gypsum (jĭp´ sŭm)	Can be scratched with fingernail.
3	Calcite (kăl´ sīt)	Cannot be scratched with fingernail.
4	Fluorite (flo͞o´ ō rīt)	Will scratch a penny.
5	Apatite (ăp´ ȧ tīt)	Will scratch a penny; can be scratched by an iron nail.
6	Orthoclase (ôr´ thō klās)	Will scratch glass; can be scratched by an iron file.
7	Quartz	As hard as an iron file.
8	Topaz	Will scratch an iron file (also quartz).
9	Corundum (kō rŭn´ dŭm)	Will scratch an iron file.
10	Diamond	Hardest known substance.

The hardness of a mineral is found by using it to make scratches on the minerals in Mohs' scale. It is necessary to find out which minerals in the scale the unknown mineral can and cannot scratch. Then the hardness can be determined. For example, quartz (7) is harder than orthoclase (6) but softer than topaz (8). Any mineral that scratches quartz but not topaz is said to have a hardness of between 7 and 8. This mineral will also scratch minerals below quartz but will not scratch any above topaz.

Simple materials can be used to help determine the hardness of a mineral on Mohs' scale.

fingernail - hardness of about 2.5; will scratch gypsum (2), but not calcite (3).

penny - hardness of 3; will just about scratch calcite (3), but not fluorite (4).

sharp edge of a piece of glass or blade of a jackknife - hardness of 5.5; will scratch apatite (5), but not orthoclase (6).

iron file (workman's tool) - hardness of 6.5.

Density. Some rocks are heavier than others of the same size (that is, they are more dense). Density alone is not enough to identify minerals. Several minerals may have the same density.

Density and weight are confusing concepts for many children. They will observe that some samples are of different sizes, but many are similar in weight. Children may suggest that a rock is heavy for its size.

In order to get agreement on weight, teachers may wish to suggest to children that they call almost all rocks medium and use heavy and light for those at each extreme.

The activities on density are included to develop an awareness of this property. Crude hand measurement and an equal arm balance are utilized.

Motivation for the Study

Some suggested ways to initiate the topic are the following:

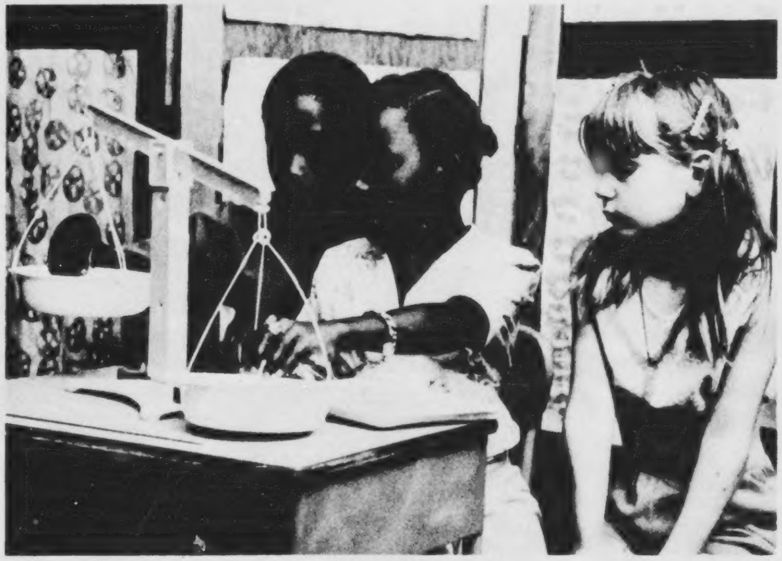
#Have a "Rock Hunt." Ask children to bring rocks they have collected.

#Visit the Museum of Natural History.

#Visit a nearby construction site to observe the cut-away in the land.

#Build a display of rocks and children's books about rocks. Organize the display according to properties. Add to the display throughout the year.

Take a walk in the immediate community to observe how rocks are used.



Simple scales show weight comparisons

Concept	Performance Objectives
Minerals. Natural substances (element or compound) found in **Earth. Minerals have definite chemical composition.**	Given an assortment of rocks and minerals, the child will be able to describe each by its properties.
Rocks. Solid material made of one or more minerals.	
Properties of Rocks. Rocks have characteristics or attributes.	
Color. Rocks have distinct colors depending upon their mineral content.	Given a set of rocks and minerals, the child will be able to classify by a chosen property.
Texture. Relative roughness or smoothness. The texture depends upon the size of the grains.	
	Given an assortment of rocks and minerals, the child will be able to match them to an equivalent set.
	Given a set of rocks, the child will be able to describe the texture of each.

Materials Needed	Learning Activities
cardboard trays collection of rocks and minerals handlens small plastic bags	#Have a "Rock Hunt." Ask several children to choose a rock and describe its properties. Have them compare the rocks and group by a chosen property. Ask: What people hunt for rocks? (archaeologists, geologists, owners of rock shops, and the like) What do they do with the rocks when they find them?
cardboard trays collection of rocks and minerals handlens	Ask children to examine the rocks and tell how they are alike, different. Describe their properties--color, size, shape, texture. Have the children look at the rocks with a handlens. Then ask them to choose a property and sort the samples according to that property. Discuss how various children sorted. Begin to build a class chart of "Properties of Rocks" similar to the one below. As children have additional experiences with rocks and minerals and discover other properties, add these words to the chart.

Properties of Rocks

pink	smooth	shiny	heavy
gray	blackish-gray	thick	flat
rough	layered	dull	powdery
sparkly	pointed	speckled	gold

Materials Needed	Learning Activities
sample set of rocks and minerals	Have children look at the sample set and try to match the rocks with a given set of rocks.
smooth and rough rocks paint paper	Have children dip the rocks into paint and press on paper; then compare and describe the prints (rough/smooth, irregular or jagged). #Ask: What people use this process in their work? (artists and block printers)

Concept	Performance Objectives
Texture. (continued) Relative roughness or smoothness. The texture depends upon the size of the grains.	Given a set of rocks, the child will be able to describe the texture of each.
Luster. The way a rock or mineral reflects light. Rocks and minerals may be dull, glassy, greasy, or metallic in luster.	Given a set of rocks, the child will be able to classify by the property, luster.
Streak Color. When a rock or mineral is rubbed on hard, unglazed porcelain, it makes a characteristic streak.	Given a set of rocks, the child will be able to classify according to streak color.

Materials Needed	Learning Activities
wet plaster in dish bowl or jar lid vegetable oil rocks of various textures	Pour a small amount of wet plaster solution (about ½" to 1", or 1 to 2.5 cm depth) in a bowl or jar lid. Put vegetable oil on the rocks and set them in the solution. When the plaster hardens, lift out the rocks. Have children observe and describe the impression.
plaster clay rocks of various textures	Make a clay cast of a rock; remove the rock. Pour plaster into the clay cast; remove the clay. Ask: How does it look? #Discuss with the children how the same idea can be applied to the jobs of dentists (making dentures), potters, candlemakers, and plastic surgeons.
collection of rocks and minerals electric shoe buffer or rock polisher	#Ask children to describe the samples. Polish. Ask: What happens to the rocks? How did they look before? after? Invite a lapidarist (person who cuts and polishes precious stones) to explain his work.
collection of rocks	Set the rocks in a place to catch the light. Have children handle, observe, and describe their properties. Ask: What descriptive words can be added to the "Properties of Rocks" chart? (Properties, such as clear, greasy, diamond-like, silvery, pearly, may be identified by the children.) Note: The teacher may wish to number the rocks for the purpose of common reference for the next series of activities.
collection of rocks streak plates	Divide the children into groups. Each group should test each sample. Have each group mark on the streak plate, describe, and record findings. Note: Children should wipe the streak plates clean so they can be reused.

Concept	Performance Objectives
Streak Color. (continued) When a rock or mineral is rubbed on hard, unglazed porcelain, it makes a characteristic streak.	Given a set of rocks, the child will be able to classify according to streak color.
Magnetism. Some minerals, such as magnetite and lodestone are magnetic and will be attracted by a magnet.	Given a specific set of rocks, the child will be able to classify those that interact with a magnet.

Materials Needed

Learning Activities

collection of rocks
pieces of paper
streak plates

Divide the children into groups. Each group should test each sample. Have the children try to write on paper with each rock. Observe and compare findings. Then ask them to try to write on the streak plates. Record findings on a chart similar to the following:

Rock	Will It Streak on Paper?		Will It Streak on Plate?	
#___	yes		yes	brown
#___	yes	black	yes	black
#___	no		yes	blackish-gray

paper
collection of rocks and
minerals

Let children choose several rocks and minerals which they would like to test. Have them record their findings for each sample on a chart similar to the following:

Rock	Luster	Texture	Streak
#___	shiny	bumpy	black
#___	dull	sharp	white
#___	sparkly	rough	reddish-brown

collection of rocks
magnets

Have children test each rock with the magnet and record if there is interaction between the rocks and the magnet. Ask children to bring in other rocks which they think may interact with the magnet. Test. Ask: What is your evidence?

bulbs
collection of rocks
dry cell
wires

Have children test to see if any of the rocks will conduct electricity. Record results by making a picture record or a chart.

Concept	Performance Objectives
Density. The relative heaviness of a piece of rock. The weight per unit volume.	Given a set of rocks or minerals and an arm balance, the child will be able to order by weight.

<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td>suggested samples: pumice, limestone, sandstone, graphite, and galena
arm balance</td><td>

Have children compare the weight of four rocks by hand, then compare two of the rocks. Ask: Which is lighter, heavier? Compare the other two. Ask: Which is lighter, heavier? Compare the four rocks again. Ask: Which is the lightest, heaviest? Compare the remaining two. Ask: Which is lighter, heavier? Have children order (seriate) and record on a chart from lightest to heaviest.

Have children use an arm balance and compare the four rocks. Have them order from lightest to heaviest and record. Ask them to compare the hand chart with the balance chart. Children should begin to realize that an instrument is needed in order to make more accurate measurements than the hand.

Have children compare the properties of galena and pumice. Ask: Why do you think one is heavier than the other?

</td></tr>
<tr><td>4 labeled rocks of approximately the same size, but different weights
suggested samples labeled: A. pumice; B. graphite; C. sandstone or limestone; D. galena</td><td>

Compare by hand rocks B and D. Ask: Which is lighter, heavier? Do the same with rocks A and C.

<table>
<tr><th>Lighter</th><th>Heavier</th></tr>
<tr><td>B</td><td>D</td></tr>
<tr><td>A</td><td>C</td></tr>
</table>

Have children compare by hand the four rocks. Ask: Which is lightest, heaviest? Have them lift the two remaining rocks. Ask: Which is lighter, heavier?

$$4 \left\{ \begin{array}{l} \text{Lightest - A} \\ \text{Heaviest - D} \end{array} \right. \qquad \text{2 remaining} \left\{ \begin{array}{l} \text{Lighter - B} \\ \text{Heavier - C} \end{array} \right.$$

Seriate on a chart from lightest to heaviest. Have children use an arm balance to compare the four rocks; seriate. Make a chart. Have children compare the hand chart with the balance chart.

<table>
<tr><th colspan="2">Hand</th></tr>
<tr><td>Lightest</td><td>A</td></tr>
<tr><td></td><td>B</td></tr>
<tr><td></td><td>C</td></tr>
<tr><td>Heaviest</td><td>D</td></tr>
</table>

<table>
<tr><th colspan="2">Balance</th></tr>
<tr><td>Lightest</td><td>A</td></tr>
<tr><td></td><td>B</td></tr>
<tr><td></td><td>C</td></tr>
<tr><td>Heaviest</td><td>D</td></tr>
</table>

</td></tr>
</table>

Concept	Performance Objectives
Interaction. Objects interact when they do something to each other.	
Interaction with Water. When rocks interact with water, they may change color, dissolve, partially fall apart, sink, or float.	Given a set of rocks and water, the child will be able to demonstrate and describe evidences of interaction.
Interaction with Vinegar. Rocks with a calcium base react to vinegar.	Given a set of specific rocks and vinegar, the child will be able to demonstrate interaction.

<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td>pan of water
collection of rocks</td><td>Have children look at the rocks and describe the color of each rock before it is put into the water. Have children put the rocks in the water one at a time. Ask: How do they look? What is the difference? Some children may wish to see what will happen if the rocks are left in the water overnight. Record findings on a chart similar to the one below.
<table>
<tr><th>Rock</th><th>Before We Put It in Water</th><th>After We Put It in Water</th></tr>
<tr><td>#___</td><td>brown</td><td>black-yellow</td></tr>
<tr><td>#___</td><td>light green</td><td>blackish green</td></tr>
<tr><td>#___</td><td>red</td><td>darker red</td></tr>
</table>
</td></tr>
<tr><td>limestone
2 other rocks
vinegar
3 plastic tumblers</td><td>Put a piece of limestone in a tumbler. Put the other two rocks in two separate tumblers. Pour vinegar on each rock. Ask: What happens? Was there interaction? What is your evidence? Have children describe and record observations.</td></tr>
<tr><td>collection of rocks
variety of liquids
plastic tumblers</td><td>Try other liquids to test the rocks (water, lemon juice, a carbonated beverage, milk). Ask: Was there interaction? What is your evidence?
#Explain how a chemist uses similar practices in his work.</td></tr>
<tr><td>limestone
marble
white writing chalk (not synthetic)
calcite
white vinegar
plastic tumblers
handlens</td><td>Divide the class into groups. Give each group a tumbler and one of the suggested samples. Have each group describe its rock. Put each sample in the tumbler containing approximately $\frac{1}{4}$" (5 mm) white vinegar. Leave overnight. The following day observe the rocks and discuss the interaction of the rocks with the vinegar. Have children use the handlens to examine the changes and compare with the observations the day before.
Discuss with children if they think the same interaction would occur if they used less vinegar, substituted a different liquid for vinegar, or used colored chalk instead of white chalk. Let each group decide how it wishes to change the experiment. Have children record their findings with a picture record or written record each time they change the experiment.</td></tr>
</table>

Concept	Performance Objectives
Hardness. The relative resistance to scratching. Rocks and minerals vary in hardness from soft talc to hard diamond.	Given a set of rocks, the child will be able to classify according to hardness.
	Given a set of rocks, the child will be able to determine the comparative hardness of each.
	Given a set of rocks, the child will be able to order them according to their hardness.

Materials Needed	Learning Activities
collection of rocks and minerals objects to use for scratching samples (pin, coin, nail, paper clip, another rock)	Have children use various objects to scratch the samples to find out which are easy to scratch and which are hard. Classify. Some children may decide to group their samples into two groups--rocks that can be scratched with a fingernail and rocks that cannot; or rocks that can be scratched with a penny and rocks that cannot. Other children may decide on more than two groups; for example, rocks that can be scratched with a fingernail, rocks that can be scratched with a penny but not a fingernail, rocks that can be scratched with a nail but not a penny, rocks that can't be scratched at all. Others may decide to order (seriate) theirs from the softest to the hardest or vice versa.
a collection of rocks and minerals a penny a nail a knife blade (optional; teacher may wish to use this to demonstrate) baby food jars	Divide the children into groups. Have them scratch the rocks with their fingernails, the edge of a penny, and a nail. Also, have them try to scratch the rocks on a baby food jar. Discuss the findings. Sort the rocks. Construct a simple hardness chart similar to the one below. Three categories may be sufficient for some children. "Our Hardness Chart" Very Soft - Rock can be scratched with fingernail. Soft - Rock can be scratched with the edge of a penny. Medium - Rock can be scratched with a nail. Hard - Rock cannot be scratched with a knife blade. Very Hard - Rock will scratch glass.
collection of rocks and minerals hardness chart	Have children try to scratch one sample with another and order according to their hardness (softest to hardest; hardest to softest). Use a hardness chart as a reference source.

Concept	Performance Objectives
Composition. The various minerals that make up a rock.	The child will observe that rocks are composed of more than one mineral.
Geologists. Scientists who study the history of Earth, especially as recorded in rocks.	Given a reference source (filmstrip, study prints, book, or like material), the child will be able to find and explain specific information about a given rock.
Utilization of Rocks and Minerals. People use rocks and minerals in their daily lives.	Given a variety of sources, the child will be able to collect and communicate information about the uses of rocks by people.

Materials Needed	Learning Activities
samples of granite, feldspar, quartz, and mica heavy cloth bag and hammer (for Version 1)	This activity is included to help children understand that rocks are made up of more than one mineral. Version 1 is a teacher demonstration. Version 1. Place the granite sample in a heavy cloth bag (as a precaution against flying splinters from the rocks). Hammer and break into small pieces. Remove from the bag and compare the little pieces with the samples of quartz, mica, and feldspar.
handlens	Version 2. Have children use handlens and observe carefully the samples of granite. Call attention to the differences in the colors and compare with the samples of feldspar, mica, and quartz. See if children can match these samples with the particles in the granite.
filmstrips reference books study prints cassette tapes transparencies	On large index cards or a chart, list questions about rocks. (See suggested examples below.) Ask children to report their findings by telling, constructing, demonstrating, or writing. Suggested Questions: How is the rock used? How is the rock made? Where is it found? What is the origin of the name of the rock?
books filmstrips films study prints magazines	#Obtain as many appropriate reference materials as possible. Provide time for the children to engage in reference work to find out how people use rocks in their homes, work, school, and community. Record information (picture or written). Or develop a class chart on the uses of rocks. The following items serve as examples: jewelry table tops houses factories salt slate pipe (copper) chalk #Develop a class chart of the occupations related to rocks and minerals, such as geologist, jeweler, miner, construction worker, or lapidarist.

Concept	Performance Objectives
Utilization of Rocks and Minerals. (continued) **People use rocks and minerals in their daily lives.**	Given a variety of sources, the child will be able to collect and communicate information about the uses of rocks by people.
Conservation. Preservation of minerals. People must conserve minerals. They cannot be replaced.	The child will be able to explain how people can conserve minerals.

Materials Needed	Learning Activities
books films filmstrips U.S. map world map	#Have children read and explain the different uses of mineral ores in the United States. On a U.S. map, label the location of important mineral deposits; tell how they are excavated. Some children may wish to use a world map to locate sources of mineral deposits in other countries.
books films filmstrips	Discuss with children what will happen if man depletes the supply of minerals. Discuss the need for and the importance of conserving minerals. Some children may wish to do reference reading to find out ways now being considered.

Bibliography - Rocks and Minerals

Beauchamp, Wilbur. *Basic Science Handbook, K-3*. Glenview, Illinois: Scott, Foresman and Company, 1961.

Crosby, Phoebe. *Junior Science Book of Rock Collecting*. Champaign, Illinois: Garrard, 1962.

Gans, Roma. *The Wonder of Stones*. New York: Crowel-Collier Press, 1963.

Heavilin, Jay. *The Beginning Knowledge Book of Rocks and Gems*. New York: The Macmillan Company, 1964.

Hyler, Nelson W. *The How and Why Wonder Book of Rocks and Minerals*. New York: Grosset and Dunlap, 1960.

Knight, David C. *Let's Find Out About Rocks and Minerals*. New York: Franklin Watts, 1969.

Page, Lou W. *Rocks and Minerals*. Chicago: Follett Educational Corporation, 1962.

Pine, Tillie S. and Joseph Levine. *Rocks and How We Use Them*. New York: McGraw-Hill Book Company, 1967.

Podendorf, Illa. *The True Book of Rocks and Minerals*. Chicago: Children's Press, 1958.

Shuttlesworth, Dorothy E. *The Doubleday First Guide to Rocks*. New York: Doubleday and Company, 1963.

Syrocki, B. John. *What Is a Rock?*. Westchester, Illinois: Benefic Press, 1961.

Zim, Herbert S. *Rocks and How They Were Formed*. New York: Golden Press, 1961.

Mediography - Rocks and Minerals

	Division of Resource Services A-V Number
Earth: Man's Home	886
ESS Rock Collection and Equipment Kit	
Finding Our About Land, Air, and Water (Basic Primary Science - Group I)	5728
Our Home the Earth (Science for Beginners Series)	6462

SOIL

Rationale

Most young children like to play and dig in the soil. Many like to make mud pies. They have observed that some living organisms make their homes in soil. Some children have planted seeds in soil and may have realized that soil protects the germinating seeds. Others have helped their families tend flower and vegetable gardens and know that soil is necessary for growth.

Background for the Teacher

Children frequently call soil "dirt." The teacher should accept the word "dirt," but explain that scientists usually call it "soil." Often children have been given the impression that "dirt" is undesirable and something to be avoided. Adults have reminded them not to "get dirty." It is important to develop with children an understanding that soil is not something to be disliked, but rather to be appreciated as an important resource which is useful and of great value. Soil provides food, clothing, material for building homes and other structures, jobs, and recreation for people.

The solid part of Earth is made up of rocks and soil. Soil is composed of tiny particles of rocks and minerals which are mixed with decaying plant and animal material called humus. Soil is necessary for the production of plants. All animals depend on plants for food, either directly or indirectly.

Soil is formed from the weathering of rock. New soil is constantly being formed. The formation of soil is a long, complex process. Rocks are broken into small pieces by weathering. Changes in temperature, water, gases in the air, and organisms interact with the rocks. Soil has decayed plants and animals in it. Trees and plants growing on rocks help to break the rock into soil.

Earthworms play an important part in soil formation. As they move through topsoil, they make tunnels which let in water and air. As the earthworms chew the soil, they take pieces of dead plants and animals. The materials not used by the worms pass through their bodies and are deposited on top of the soil. The worms also make tunnels in subsoil, carrying the soil to the surface; topsoil and subsoil become mixed.

Soil has properties: color, texture, composition, and absorption. It varies in location, depth, the size of rock fragments, and clumps. An exposure of soil layers, such as a bank, gully, or excavation is called a soil profile. A soil profile includes topsoil, subsoil, weathered rock, and bedrock.

Topsoil. Usually the top layer of fertile soil; contains humus, roots of grass, weeds, and other plants.

Subsoil. The layer beneath the topsoil; contains pebbles and little or no humus; contains materials received from leaching the topsoil; often receives its color from these materials.

Weathered Rock. The layer beneath the subsoil; not true soil; often provides the parent materials from which soil is made.

Bedrock. The layer beneath the weathered rock; varies in type and depth. The bedrock in Cincinnati is predominately limestone.

Soil contains different kinds and sizes of minerals and rocks. It is often classified according to the material that is found in greatest quantity within it.

Sandy Soil. Mostly sand, some clay, little or no humus; does not hold water well; has few minerals that plants can use.

Clay Soil. Mostly clay, a little sand, and humus; holds water very well; dries slowly; sticky when wet; very hard when dry.

Loam. Dark brown or black; contains much humus, some gravel, sand, and clay; best for growing most crops.

As children learn about the soils of their community, the teacher should avoid causing any child to feel embarrassed if he comes from a region with poor soil. The teacher should emphasize that no matter where a person looks, the soil will be different from that of another location; although in some instances, the differences may be slight.

If children are asked to bring in a small sample of soil, the teacher should remind them to ask permission from the owners before they take any. Even though the quantity may be a small amount, it is desirable for children to develop an understanding of ownership of property.

Geologic Changes. The surface of Earth seems to be solid and rather permanent, but it is always changing. The rocks that make up the surface are continually being broken up and carried away. Weathering and erosion are the two forces continuously at work.

Weathering. The process of breaking down rocks is called weathering. It is caused by the actions of sun, water, and air.

Mechanical weathering is the breaking down of rocks into small pieces. It may be caused by water seeping into cracks of rocks and freezing. The freezing water expands, exerts pressure, and causes pieces of rock to break off. This usually takes place when the days are above freezing and the nights below freezing. Or the rocks may be heated during the day and cooled by night with the temperature above freezing in both instances. When rocks are heated during the day, the minerals in them expand. Water seeps into the rocks, combines with the minerals, and causes them to swell and form cracks in the rocks. At night they cool, contract, and cause the outside to peel off in thin layers or sheets.

Living organisms also cause mechanical weathering. As plants grow, their roots work into small cracks in the rock and cause it to split and crumble. Burrowing animals dig and expose new rock surfaces for weathering. Earthworms make tiny passage ways in the earth which permit air and water to enter the soil easily.

Wind is also a weathering agent. As it blows against rock, it carries particles that rub against the solid rock and wear it away. Pebbles, rocks, and boulders are made smooth this way.

In chemical weathering, chemical changes take place in the rock and form new products that can be carried away more easily than the original rock.

When plants and animals die and decay, acids are formed. These acids attack the rock and make it crumble.

Carbon dioxide gas in the air can cause chemical weathering in certain rocks, such as limestone. When the carbon dioxide from the air dissolves in water, it forms a weak acid which attacks the rock and forms materials that dissolve easily in water. Oxygen in the air combines directly with many minerals in rocks which form materials that crumble easily.

Erosion. The process of taking away the products of weathering and depositing them elsewhere is called erosion. As one location loses soil; another gains some soil. Water, ice, and wind are the forces that produce erosion.

When rain water falls on the surface of Earth, some of it seeps into the soil and stays as ground water; some evaporates into the air; the rest flows over the surface in streams and rivers. This running water carries with it soil and rocks and deposits them in lakes and oceans. As the water flows in the streams and rivers, it wears away the beds and makes the streams and rivers wider. The particles of rock in the water also act as weathering forces and wear away more of Earth's rock.

As ocean waves pound against the rocks and land along the shore, they wear away and carry off particles. Currents and waves also carry sand and pebbles to the shore and make sandy beaches. Storms and strong undertows often carry away beach materials faster than the waves can deposit them. Some waves form sandbars and sandy islands by depositing materials off the shore.

Wind erosion is common in dry areas where there are few plants, shrubs, or trees to cover and protect the ground. When the wind slows down, it deposits materials. Sand dunes are the most common wind deposits.

Motivation for the Study

Suggested ways to initiate the topic are the following:

Go outdoors to observe the earthworms on the sidewalk or on top of the soil after a rain. Or observe the water in the gutters in the street.

Take a walk and bring back to the classroom a small quantity of different types of soil found in the neighborhood. A teaspoonful of each type for each group is sufficient to view under a handlens.

Take a walk through the neighborhood and look for areas where a soil profile can be seen.

Make pottery with clay.

Plant seeds in soil.

Discuss how particles sting the eyes on a windy day.

Concept	Performance Objectives
Soil. A part of Earth's crust. The composition of soil varies greatly from place to place. Soil is composed of a mixture of solid (organic and inorganic materials), liquid (water), and gas (air).	Given samples of soil, the child will be able to describe the properties of each.
Dirt. Commonly used to refer to soil.	
Properties of Soil. Soil has characteristics or attributes.	
Color. Soils vary in color. The color of a soil depends upon its composition.	
Texture. The size of grains, gravel, or clumps found in soil. Soil may be fine, coarse, rocky, or clumpy.	

Materials Needed	Learning Activities
old tablespoons trowel soil jar work trays	Ask children to bring in a sample of soil or take them on a field trip to collect soil samples. Have them label **the location where they obtained their soil** samples; or, make a mural map of the location where each type was found. Let children examine their soil samples and describe the color and texture of the various samples. Ask: How are they alike, different?
samples of sandy, clay, and loam soils handlens plastic tumblers water	Have children put one kind of soil in each tumbler. Let them observe the samples with and without a handlens. Ask them to feel the soil and describe the properties of each sample; for example, its color and texture (smooth, sticky, lumpy). Have a child pour some water into each tumbler and feel and describe each sample.
chart paper marking pen	Make charts similar to the following examples and continue to add new properties as children work with soil.

Properties of Soil

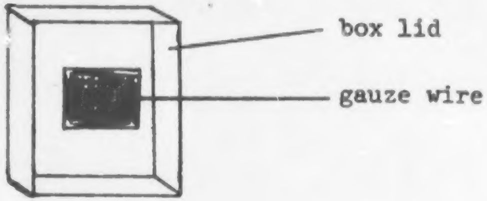
black	sticky	lumpy
yellow	smooth	hard
brown	fine	soft

Properties of Soil

Color	Texture	
black	smooth	lumpy
yellowish	fine	coarse
brown	soft	gritty
grey	hard	

Materials Needed	Learning Activities
rocks (sandstone is desirable) paper handlens jar	Give two pieces of sandstone to each child or group. Ask children to rub the pieces together over the paper. Ask: What happens when the two pieces are rubbed together? How do the particles feel? Give children a handlens to observe how they look. Have them put some of the particles in a jar; label the materials in the jar.

Concept	Performance Objectives
Composition. The organic and inorganic materials that make up soil.	Given samples of different kinds of soil, the child will be able to describe the components of each.
	Given a sample of soil, the child will be able to identify materials found in it.

Materials Needed	Learning Activities
handlens samples of topsoil, clay and sandy soils cardboard trays	Place a small sample of each kind of soil on the cardboard trays for each group of children. Ask them to examine the soil with the handlens, name the objects, and compare the objects found. On a chart, list the objects observed. Ask children if they've observed small bugs crawling around inside the soil. Discuss what they think happens to the bodies of the bugs when they die. Ask: What happens to plants when they die? What happens to the leaves that fall in autumn? (The remains of dead plants and animals decay and become part of the soil. The decaying organic material is called humus.)
cardboard box lid gauze wire (fine screen) newspaper soil from the woods container for soil handlens masking tape	Cut out a square hole in the box lid, leaving a 1" (2.5 cm) border. Fasten the gauze wire with masking tape to the edge of the lid. Add soil and sift through wire onto a piece of newspaper. Break up any large clumps. Ask: What objects are left on the screen? (pebbles, sticks, leaves, insects) Have children classify by living and nonliving. Give children a handlens to observe the tiny sifted particles, and ask them to describe the particles. 
samples of soil strainer pail water	Have a group demonstrate the following activity to the class. Ask one child to hold a strainer over a pail and pour the sample of soil into the strainer. Have another pour some water into the strainer. Repeat this several times. Ask: What was observed? Guide discussion with questions similar to the following. Why did some of the soil go through the strainer when water was added? Why did some soil remain in the strainer? Why did the small rocks remain? What other objects remained? If leaves or twigs remained in the strainer, have a child take the leaf and tear it into small pieces. (Explain that this is what happens to leaves and twigs; eventually they will become a part of the soil.)

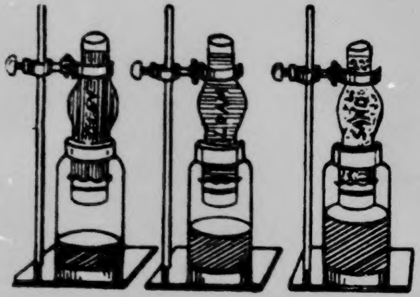
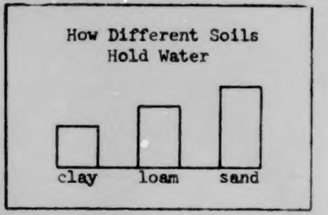
Concept	Performance Objectives
Composition. (continued) The organic and inorganic materials that make up soil.	Given a sample of soil, the child will be able to identify materials found in it.
	Given appropriate materials, the child will be able to make soil.
	Given different kinds of soil, the child will be able to determine the ability of each to promote plant growth and state reasons why.

Materials Needed	Learning Activities
a cup of sandy, light-colored soil a cup of topsoil handlens strainer newspaper	Have children feel and smell the soil samples. Ask: How are they different? Have a child put each soil sample through a strainer and identify the material that fell through the strainer onto the newspaper. Ask: What is left? In which soil are there more bits of plant material, more bits of sand and rock?
chart paper marking pen	As the preceding activities are developed or as a culminating activity, record on a class chart what the children found in soil. What We Found in Soil pebbles roots grass sticks worms dead bug berries sow bugs ants twigs seeds dried leaves sand water air bubbles insect casing
sand powdered clay dried leaves water container flower pot seeds	Have children make soil. Crush the clay into small particles. Mix it with the sand. Crumble the dried leaves and mix with the sand and clay. Add water. Put in a flower pot and plant some seeds in it. Note: The teacher may wish to interrelate these activities with growing seeds in the Life Science section.
seeds for planting samples of topsoil and subsoil containers for planting	#Compare both kinds of soil. Look for differences in color, pebbles, stones, and humus. Plant seeds in the topsoil and subsoil. Keep all other conditions the same. Observe which soil produces the sturdier plant. Discuss why this happened.

Concept	Performance Objectives
Composition. (continued) The organic and inorganic materials that make up soil.	Given different kinds of soil, the child will be able to determine the ability of each to promote plant growth and state reasons why.
Interaction. Objects interact when they do something to each other.	
An Interaction of Water and Soil. **Soil interacts with water when it rains or snows.**	The child will be able to demonstrate that soil contains water.
Absorption. Soil has the ability to hold water.	Given samples of specific soils and a specific amount of water, the child will be able to determine the ability of each to absorb water.

Materials Needed	Learning Activities
samples of **loam, clay and sandy soils** containers for planting	#Repeat the preceding activity using samples of **loam, clay and sandy soils. Ask:** How are the farmer, nurseryman, horticulturist, and gardener affected by **different kinds of soil? What do they do?**
sample of soil that seems dry glass jar with a lid	Put some soil that seems dry into a jar. Put the lid on the jar and place on top of the radiator if possible. Have children observe the sides of the jar. (Moisture should begin to form on the sides of the container in a short time.) Discuss that there must be water in soil. (Children may not think that there is water in the soil unless it feels wet.) Discuss where the rain and snow go when they reach the soil. Note: If the concept of water cycle has been developed previously with the children, the teacher may wish to review it at this time. (See page 198.)
½ cup of garden soil glass cooking pot with a lid an electric grill	Put the soil into the glass cooking pot. Cover the pot with the lid. Heat the pot to medium. Have children observe what happens as the soil is heated.
water pail of dry soil	Pour the water into a pail of dry soil. Have children observe what happens. (The bubbles of air will rise to the top.)
sand, clay, and loam 3 containers of equal size water	Place equal amounts of sand, clay, and loam in identical containers. Begin with a measured amount of water. Pour onto soil until water begins to collect over soil. Ask: Which of the three kinds absorbs the most water? Why?
sand, clay, and topsoil 3 identical pots 3 foil pans	Have the children fill each pot with a different type of soil. Place in a foil pan. Pour an equal amount of water into each foil pan. Ask: Which absorbs the most water?

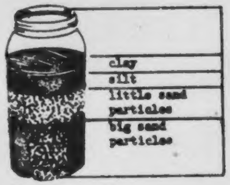
Concept	Performance Objectives
Absorption. (continued) Soil has the ability to hold water.	Given samples of specific soil and a specific amount of water, the child will be able to determine the amount of water that flowed through each sample.
An Interaction of Air and Soil. Air is pushed out of soil as water enters it. Soil that is well supplied with air is needed in order to germinate seeds and grow plants.	The child will be able to demonstrate that soil contains air.

Materials Needed	Learning Activities
sand, clay, and loam 3 plastic tumblers 3 large juice cans (same size)	Punch nail holes in the center of the bottoms of the juice cans. Fill one can with clay, the second with sand, and the third with **loam.** Label and place the cans on the tumblers. Make sure the holes are over the openings of the tumblers. Slowly pour one cup of water into each can. After an hour, measure the water in each tumbler. Ask: Which has the most water, the least? Why?
samples of clay, loam, and sand cheesecloth rubber bands water 3 lamp chimneys ring stands with clamps 3 jars or convection boxes	Cover the ends of each glass lamp chimney with cheesecloth. Fasten securely with rubber bands. Put the end with the cheesecloth into the convection jars. Attach the chimneys to ring stands with clamps. Put the sample of clay into one chimney; loam into another; sand into another. Fill each about 2/3 full. Pour equal amounts of water into each. Ask: How long does it take for the water to drip into the jars? How **much** water comes from the clay? loam? sand? How long does the water continue to drip from each soil sample? Cut strips of paper to equal the height of the water in each jar. Make a graph labeling the strip to correspond with the soil sample. Continue to make observations and record any changes on the graph.  
samples of soil plastic tumblers **water**	Place some loose soil in the tumblers. Fill with water above the level of the soil. Ask: What rises from the soil? (air bubbles) Shake gently to create more bubbles of air. Repeat the question.

Concept	Performance Objectives
An Interaction of Organisms and Soil. Earthworms make tunnels in soil.	Given earthworms and appropriate materials for making soil, the child will be able to describe how earthworms make soil.
An Interaction of Organisms and Soil. Living organisms break rock into soil.	The child will be able to explain how growing plants can break up rock.
Soil Profile. An exposure of soil layers, such as a bank, gully, or excavation.	Given appropriate materials, the child will be able to demonstrate layering.

Materials Needed	Learning Activities
vacant lot or appropriate place on school grounds	#Take children for a walk on the school grounds or a vacant lot. Have them look for earthworm holes. (These can be located by looking for the little piles of earth which the worms leave near their holes.) #If the chosen location is rich in earthworms, ask children to measure off an area and count the number of holes observed.
jar with holes in lid topsoil and sand water earthworms leaves black paper (to fit jar) tape	Fill the jar with soil; water lightly. Put some earthworms on top of the soil. Lightly cover the soil with sand. Place leaves on the sand. Cover the jar. Have children observe and draw a picture of the observation. Tape black paper around the jar. Let it stand for a few days. Take the paper off and call attention to what has happened in the jar. Have children compare how it looks with the picture of the first observation.
	Take children for a walk and observe plants growing between cracks in sidewalks, between rocks in walls, next to foundations of buildings, and through blacktop driveways. Have children find trees whose roots have caused the cement to crack.
lima bean seeds jar water soil plaster pan	Plant some lima bean seeds in a pan filled halfway with soil. Wet the soil. Cover the soil with a thin layer of plaster of Paris. The plaster will harden. Ask: What happens as the seeds grow into plants? The properties of plaster of Paris are similar to the properties of some rocks. Relate the lima bean plants to rocks being changed by organisms.
films filmstrips study prints	If there is a soil profile available in the nearby community, take children on a walk to observe the soil layers. Or, use the suggested resources to identify, describe, and discuss the layers.

Concept	Performance Objectives
Soil Profile. (continued) An exposure of soil layers, such as a bank, gully, or excavation.	Given appropriate materials, the child will be able to demonstrate layering.
Weathering. The process of breaking down rocks caused by the actions of sun, water, and air.	The child will be able to state examples of weathering and causes.

Materials Needed	Learning Activities
½ cup (118 ml) each: coarse gravel, fine sand, and rich soil quart jar water	Have children place the materials in the quart jar; fill with water. Have a child shake the jar hard. Ask children to observe the materials as they settle into layers and identify each layer. Discuss this layering in relation to the soil layers on Earth.
tape handlens spoon plastic tumblers 2 jars with lids enough soil to fill jars 1/3 full water piece of cardboard approximately the height of the jars paper towels	Fill one jar about 2/3 full of water. Put soil in the water until the jar is almost full. Cover and shake well. Put the jar aside; let the soil settle. Ask children to observe how the soil looks. (Layers of soil should form.) Place the cardboard at jar level. Let the children determine approximately where each layer of soil stops. Tape the cardboard on the jar. Draw a line on the cardboard to show the separation of the layers. 
	Have children obtain soil samples from different locations and record on the jar where the samples were collected. Repeat the above activity. Have them compare the two soil samples at a time and observe the material in the thickest layer, the thinnest layer.
	Pour off the water carefully; spoon out samples of each layer and place in plastic tumblers. Have children touch each layer with fingertips. Ask: How does it feel? Have them observe each layer with a handlens. Ask: How does it look? Compare the size of the particles.
rainy day	#Have children examine the schoolyard or street after a rain to observe the small gullies or deposits of soil and debris in various forms. Ask: How did these occur? Discuss the workers involved in disposing of them (sanitation worker, street cleaner, and the like).
	Call attention to evidences of weathering around the schoolyard and the neighborhood. Record findings on a chart.

Concept	Performance Objectives
Weathering. (continued) The process of breaking down rocks caused by the actions of sun, water, and air.	The child will be able to state examples of weathering and causes.
Erosion. The process of transporting rock and soil particles from one place to another. Water, ice, and wind are forces that produce erosion.	The child will be able to explain the process of erosion.

Materials Needed	Learning Activities
soil sprinkling can water	Make a hill of soil in the schoolyard. Put water in the can and pour over the hill. Have children observe the interaction of water and soil and record findings. Add small stones and clumps of sod to the hill of soil. Sprinkle water over the hill again. Have children observe the interaction of water and soil, water and stones, water and sod. Record findings and compare. Relate to what happens to a real hill.
sandstone or limestone sandpaper	Ask children to rub the rock with sandpaper and observe the wearing away caused by the movement.
sandstone water milk carton sieve or wire gauze pan hot plate, hot pad	Put a rough piece of sandstone into the water. Boil the water. Put rocks and water into the milk carton. Put the carton into the freezer. The next day, tear the milk carton away from the iced rock. Put the iced rock into hot water and heat until the ice is melted. Pour the water through a fine sieve or wire gauze. Have children observe the rock and the screen. Record findings.
pan with soil plastic bag and water	Freeze water in a plastic bag. Place the ice block on one end of the soil-filled pan. Tilt the pan. Have children observe what happens to the soil as the ice slides and melts. Have them observe the ice surface that rested on the soil.
	#Discuss TV, newspaper, or magazine reports of landslides or avalanches of rock, soil, or snow. Relate to erosion.

Concept	Performance Objectives
Erosion. (continued) The process of transporting rock and soil particles from one place to another. Water, ice, and wind are forces that produce erosion.	The child will be able to explain the process of erosion.
Conservation. Preservation of soil. People must conserve soil.	The child will be able to state ways he can improve the use of soil in his neighborhood.
	The child will be able to describe how he feels about people's effect on soil where he lives.

Materials Needed	Learning Activities
a windy day	On a windy day, have children observe the objects blown about and carried by the wind. Have them observe any accumulation of soil, leaves, and other materials in corners protected from the wind.
a heavy rain empty jars	After a heavy rain, ask children to collect water in the jars, bring them back to the classroom, and let the water settle. Have them observe the amount of soil carried.
	#Have children list ways soil is important to people.
	Take children on a walk around the school grounds and the immediate neighborhood. Have them look for litter under trees, on the school lawn, on the grassy strip between the sidewalk and the street, or in a vacant lot. Make a list of the objects found. Discuss with the children the materials of which the objects are made. Ask: Which of the materials will come apart soon? (These will make soil soon.) Which of the materials will last a long time? (These will not make soil soon.) Record on a chart. Discuss ways children can make their neighborhood a better place to live.

Litter We Found

Materials That Will Make Soil Soon		Materials That Will Not Make Soil Soon	
newspapers	candy wrappers	soft drink cans	glass
foil	cigarette wrappers	beer cans	metal tabs
cigarettes	string	bottles	

#Survey the schoolyard and nearby community to see if soil is being washed away. If so, discuss ways to prevent it from being eroded.

Concept	Performance Objectives
Conservation. (continued) Preservation of soil. People must conserve soil.	The child will be able to describe how he feels about people's effect on soil where he lives.
	The child will be able to state three ways people can conserve soil.

Materials Needed	Learning Activities
	Have the children observe how people conserve soil when they have steep slopes in their yards. (rock gardens, retaining walls, plantings)
	#Discuss what has been done to the slopes of I-75, I-71, and other areas to keep the soil from eroding.
	#Interview a horticulturist, nurseryman, gardener, turf man, or farmer to find out about fertilizers and why they **used them.**
filmstrips/films study prints	#Use the suggested references or have children interview people in the community to find out what people do to protect and care for soil. (Fertilizing, planting to hold soil, and contour farming are important aspects.)
	#Make a chart with children's illustrations and/or magazine pictures to show how people can help conserve soil.

Bibliography - Soil

Bethers, Ray. What Happens Underground. New York: St. Martin's Press, 1963.

Elementary Science Study. Teacher's Guide for Earthworms. St. Louis: Webster Division, McGraw-Hill Book Company, 1971.

Gates, Richard. The True Book of Conservation. Chicago: Children's Press, 1959.

Goldin, Augusta. Where Does Your Garden Grow?. New York: Thomas Y. Crowell Company, 1967.

Harvey, Lois F. Cotton Growing. Chicago: Children's Press, 1958.

Meeks, Esther K. In John's Back Yard. Chicago: Follett Educational Corporation, 1957.

Parker, Bertha M. The Earth's Changing Surface. New York: Harper and Row Publishers, Inc., 1967.

Podendorf, Illa. The True Book of Animal Homes. Chicago: Children's Press, 1960.

Pringle, Laurence. From Field to Forest: How Plants and Animals Change the Land. Cleveland: William Collins and World Publishing Company, Inc., 1970.

Russell, Helen Ross. Soil, A Field Trip Guide. Boston: Little, Brown and Company, 1972.

Shannon, Terry. About the Land, the Rain, and Us. Chicago: Melmont Publishers, 1963.

Syrocki, B. John. What Is Soil?. Westchester, Illinois: Benefic Press, 1961.

Mediography - Soil

	Division of Resource Services A-V Number
Conservation for Beginners	724
Finding Out About Land, Air, and Water (Basic Primary Science - Group I)	5728
Finding Out How Plants Grow (Basic Primary Science - Group I)	5724
Geology: A First Film	3086
Nature's Half Acre	756
Our Earth: Land, Water and Air (Introduction to Our Earth and Sun)	7736
Winter Ice: A First Film	3087

FOSSILS AND DINOSAURS

Rationale

Cincinnati is a rich fossil-bearing area. Among the rocks children collect are those which contain traces of plants and animals. Children evidence an interest in examining the details of the rocks (fossils) and comparing them with others.

Primary children usually know about dinosaurs before they enter school, although their knowledge may be more fantasy than fact. It may be the grotesque appearance of dinosaurs, their resemblance to monsters, or the mysterious aspects of long ago that fascinate and intrigue them.

Background for the Teacher

An accurate understanding of historical time is beyond the intellectual development of most young children. Thousands of years ago and millions of years ago can be referred to satisfactorily as long, long ago.

The history of Earth is recorded in its crust. Scientists have studied the layers of rock and learned about the surface and climatic changes that have occurred through the ages. Fossils of many kinds, from delicate ferns to giant dinosaurs, have been preserved in the earth. From this evidence, scientists know that plants and animals have changed over the years. Many living things from the past have become extinct.

Note: The teacher may develop the topics, fossils and dinosaurs, separately or together.

Fossils. Fossils are records of plants and animals that once lived. They are often found in limestone, shale, and sandstone deposits. Geologists use these as information to unlock some of the mysteries of the past.

Most bodies of organisms decomposed quickly after death. Some were preserved by dry air of deserts or in certain caves. Some animals may have met accidental deaths and their bodies may have been entombed in a mass of material, such as tar or quicksand, which protected their bodies from decaying. Others were preserved in shallow seas and swamps and thereby escaped the forces of disintegration by being covered quickly with mud and sand.

The teacher can capitalize on the child's play with snow, sand, and clay prints to develop the concepts involved about fossils. By examining footprints left in mud, sand, or snow, the teacher can help children make interpretations about the kind of organism that had passed by. Children can relate this to the footprints, body, and tail marks left by animals in mud or sand long ago.

Dinosaurs. Dinosaurs and other reptiles dominated Earth millions of years before man appeared. No human being ever saw a live dinosaur. It is difficult to convince young children of this because they have been exposed to toys, comic books, and television programs that show cavemen and dinosaurs fighting each other or living together happily.

The word, dinosaur, comes from the Greek; "dinos" meaning terrible and "sauros" meaning lizard. Dinosaurs are believed to have developed from a lizard-like reptile. There were two major groups: those reptile-like in their structure and those bird-like.

Some dinosaurs were small; others were the largest animals to have lived during the entire history of Earth to the present. Some walked on two feet; others on four.

Several theories have been suggested regarding the reasons dinosaurs became extinct. Some say the reason was the change of climate and the drying up of their swampy homes. This in turn caused a shortage of food. Others believed that mammals may have eaten their eggs and destroyed the young so that few were left to hatch and mature. There is no proof that any one thing caused their extinction.

Dinosaur fossils, mainly bones and footprints, have been found in regions all over the world. The fossils are usually discovered in exposed rock layers. Paleontologists excavate the dinosaur fossils and use very small tools to help prevent damage to the remains. Then they label the fossils, pack them carefully to prevent breakage, and send them to museums and universities where paleontologists study and classify the fossils. Often the fossil bones are put together and mounted as complete skeletons and put on display in museums.

Recent research about dinosaurs has questioned previous beliefs in existence for many years. Contrary to former theories, some scientists are now saying that dinosaurs may have been warm-blooded, fast-moving animals, rather than sluggish, cumbersome, and cold-blooded.

The following list is not all inclusive. It is meant to serve as a reference. Some dinosaurs and their characteristics are included. Some children may be interested in learning the names, but this should not be required.

Allosaurus (ăl ō sô′ rŭs). On display at Museum of Natural History; walked on hind legs; used small front legs for grasping and tearing food; big head; large, sharp teeth; meat-eater.

Ankylosaurus (ăng′ kĭ lō sô′ rŭs). Often compared to an armored tank; bony, plated covering on body and head; sharp row of spikes on body; bony club at end of tail; used armor as protection against attack by meat-eaters; plant-eater.

Brontosaurus (brŏn′ tō sô′ rŭs). Meaning "thunder-lizard"; one of the largest; spent much time in water to help support its tremendous weight; small head; plant-eater.

Stegosaurus (stĕg′ ō sô′ rŭs). Meaning "cover lizard"; double row of triangular bony plates down backbone; four spikes in muscular tail; clumsy and slow-moving due to body structure; plant-eater.

Trachodon (trā′ kō dŏn). Built like a duck (duckbill); approximately 2000 teeth; usually walked on hind feet; fingers joined by skin; used these to paddle in water; plant-eater.

Triceratops (trī sĕr′ ȧ tŏps). Meaning "three-horned face"; two horns protruding from enormous head; third horn on nose; may have used to chop off vegetation, used horns to protect and defend himself from meat-eating dinosaurs; plant-eater.

Tyrannosaurus Rex (tĭ răn′ ō sô′ rŭs). Meaning "tyrant reptile king"; largest and most ferocious; short, small front legs; well-developed hind legs which enabled him to move quickly; jaws, teeth, and neck well-developed for catching and devouring prey; meat-eater.

Concept	Performance Objectives
Fossils. Remains or traces of ancient plants and animals usually preserved in rocks. They may be preserved in different ways: petrified fossils, molds, prints, and whole animals and plants.	Given appropriate materials, the child will be able to demonstrate imprinting. The child will be able to tell what people learn from fossils.
Dinosaur. A lizard-like reptile that lived on Earth before man. Dinosaurs have certain characteristics (properties).	

Materials Needed	Learning Activities
clay leaves or shells	Have children take a soft piece of clay and press it flat. Have them press a leaf or shell against the surface of the clay. Ask them to remove it and observe the imprint left on the clay. Have children pretend that many years have passed and the leaf or shell has disappeared and all that is left is the trace or imprint--its fossil.
petroleum jelly casting plaster water leaves or shells paper cup or small foil container	Have children spread the petroleum jelly on the surface of the leaves or shells and place at the bottom of the paper cup. Mix a little casting plaster and water together to the consistency of pancake batter. Pour into the paper cup; let stand for a couple of days to harden. Peel away the paper cup and remove the leaf or sea shell. (A "fossil-like" object should remain in the rock-like casting plaster.)
petroleum jelly leaves modeling clay	Have children coat the leaves with petroleum jelly. Place on a piece of modeling clay flattened like a pancake. Cover with another piece of clay. Ask them to press with the heel of their hand. Pull clay patty apart and remove the leaf. Have children observe the artificial fossils embedded in clay.
fossil samples handlens	Have children bring in fossils, examine, and try to identify whether the fossil was formed from a plant or an animal.
fossil samples reference materials	#Make a display of fossils and label the location where each was found. Have children draw or find pictures of what the organisms may have looked like. Relate to the work of an archaeologist.
	On a field trip, have children hunt for fossils.
chart paper marking pen	Discuss with children their present information regarding dinosaurs. List their ideas on a chart. (At this time, make no attempt to correct their misconceptions. If there is conflict among children, record various opinions.) Compare these ideas with information found from reference materials as the children learn about dinosaurs.

Concept	Performance Objectives
Dinosaur. (continued) A lizard-like reptile that lived on Earth before man. Dinosaurs have certain characteristics (properties).	Given samples of reptiles, the child will be able to describe their characteristics.
	Given a set of dinosaur study prints, the child will be able to describe characteristics of dinosaurs.
	Given reference materials, the child will be able to collect information about dinosaurs.
	Given a set of pictures of dinosaurs, the child will be able to classify according to a chosen characteristic.

Materials Needed	Learning Activities
reptiles (turtles, snakes, lizards) habitats for the above handlens	Have children observe the properties of the reptiles. Call attention to their covering (scales or scaly plates), how they breathe (with lungs), and reproduce. (Most lay eggs; some common snakes have live births.) Have children use the handlens to observe the scales.
turtle habitat for turtle handlens	Have children use the handlens to count the main growth rings on one of the scales of the turtle's shell. (On most turtles, a new edge forms on each scale every summer.)
films/filmstrips study prints reference books	Have children observe and describe characteristics of dinosaurs. Talk about some present day reptiles and list the characteristics of these that are similar to those of dinosaurs; those that are different.
films filmstrips study prints reference books	Develop questions similar to those listed below as guidelines for research. Have children use suggested materials to find answers. Record and discuss findings. In what ways were dinosaurs alike and different? How did they move from place to place? What did dinosaurs eat? What kind of habitat did they have? In what parts of the United States did they live? In what continent or country did they live? Why did they become extinct? How do we know about dinosaurs today? #Who are the people who help us know about dinosaurs? #What kinds of work do they do?
shoebox and scraps	Have children make shoebox dioramas according to one or more classifications, such as food, habitat, or way of traveling (walking, flying, swimming; upright or on four feet). Have them write or make taped reports explaining the dioramas.
paper	Have children classify dinosaurs according to characteristics, such as armor or no armor; webbed feet or no webbed feet; walking upright or on all fours. Or have them classify according to origin (continent, country, state) and make a chart, booklet, or map.

Concept	Performance Objectives
Dinosaur. (continued) A lizard-like reptile that lived on Earth before man. Dinosaurs have certain characteristics (properties).	Given a set of pictures of dinosaurs, the child will be able to classify according to a chosen characteristic.
Plant-Eater. An animal that uses plants as a food source. Predator. An animal that uses animals as a food source. Prey. An animal that is eaten by another.	Given a set of pictures of dinosaurs, the child will be able to classify according to plant-eater, animal-eater, or both.

<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td></td><td>Have children graph (picture or bar) the size of dinosaurs (height, length, weight, or size of brain).</td></tr>
<tr><td>clay
shoebox</td><td>Have children make clay models of dinosaurs and set in appropriate habitat of shoebox diorama.</td></tr>
<tr><td>paper
pencil
crayons</td><td>From dinosaurs being studied, develop the following chart and classify according to the following:<table><tr><th>Plant Eater</th><th>Animal Eater</th><th>Plant and Animal Eater</th></tr><tr><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>pictures
paste
paper</td><td>Ask children to cut and paste pictures in order to illustrate the food chain of dinosaurs. Include food, plant-eaters, and animal-eaters.</td></tr>
<tr><td>blank film
marking pens</td><td>Have children prepare a filmstrip about dinosaurs and write or tape the script.</td></tr>
<tr><td>paper, pencil
word lists related to dinosaurs</td><td>Provide opportunities for the children to write imaginary stories about dinosaurs.</td></tr>
<tr><td></td><td>On a visit to the Museum of Natural History, plan for children to:
observe Allosaurus on display
locate the dinosaur eggs in the display case
view the film, "The Dinosaur Age"
view the film, "Message From a Dinosaur."</td></tr>
</table>

Concept	Performance Objectives
Extinct. No longer living and having no direct descendants.	The child will be able to explain how fossil remains help **people learn about dinosaurs.**
Ancestor. Some prehistoric animals have descendants living today.	The child will be able to identify some ancestors of present day animals.

Materials Needed	Learning Activities
	Discuss possible reasons why dinosaurs became extinct.
	#Interview an archaeologist to find out how people know dinosaurs lived on Earth.
	#Invite a paleontologist to bring his tools and explain why such small tools are used and how dinosaur fossils are excavated.
paper, pencil envelopes	Write to the Chamber of Commerce of different states (Montana, Wyoming, Utah, Colorado, South Dakota, North Dakota, New Mexico, Kansas, or Connecticut) to find out the location of excavation sites, "Dinosaur Parks," and museums with dinosaur specimens.
study prints filmstrips reference books	Have children compare pictures of lizards, turtles, and snakes with dinosaurs and discuss similarities.

Bibliography - Fossils and Dinosaurs

Andrews, Roy Chapman. *In the Days of the Dinosaurs*. New York: Scholastic Book Services, 1959.

Clark, Mary Lou. *The True Book of Dinosaurs*. Chicago: Children's Press, 1955.

Craig, M. Jean. *Dinosaurs and More Dinosaurs*. New York: Scholastic Book Services, 1965.

Hussey, Lois and Catherine Pessino. *Collecting Small Fossils*. New York: Thomas Y. Crowell Company, 1970.

MacFall, Russell P. *Collecting Rocks, Minerals, Gems, and Fossils*. New York: Hawthorn Books, Inc., 1964.

Wise, William. *In the Time of the Dinosaurs*. New York: Scholastic Book Services, 1963.

Mediography - Fossils and Dinosaurs

No. T-803 Dinosaurs Bulletin Board Pictures (John R. Green Company)

Fossil Box (Museum of Natural History)

Series No. 5980 Study Prints: Learning About Dinosaurs (Encyclopaedia Britannica Educational Corporation)

Stepping Into Science Book Bag (Children's Press)
True Book of Dinosaurs (cassette tape and books)

AIR

Rationale

Through experiences in their everyday lives, children are aware that air surrounds them. On windy days, they feel the air in motion. On occasion, they have had to brace themselves to walk against strong winds. They may have seen umbrellas turn inside out or observed results of severe wind damage. They have heard adults discuss air pollution and seen the air quality index (smog count) on television. Some children know they need wind to sail boats, fly kites or spin pinwheels. Perhaps no part of the children's environment makes them more aware of continuous change than does the atmosphere that surrounds them.

Background for the Teacher

The atmosphere is the ocean of air that surrounds Earth. It extends to a height of hundreds of miles, but it is exceedingly thin at such heights.

Since organisms need air in order to live, the atmosphere is extremely important. It prevents the sun's heat from leaving Earth and also serves as a protective shield to absorb the harmful ultraviolet rays that come from the sun.

Air is a mixture of colorless gases. Air is invisible, but real. It contains water as a gas called water vapor. Air has the properties of a gas. It takes up space, has weight, and exerts pressure.

Air has volume. It has no shape of its own but takes the shape of the container it is in. The teacher may wish to point out to the children that usually people refer to a container without a solid or liquid as empty when really it is filled with air.

Air has weight. A cubic foot of air weighs about 1¼ ounces (35 g).

Air also has pressure. It presses equally in all directions. The higher up, the less air there is; the pressure is less. When air pressure is increased, the air can lift or move objects. When the pressure is decreased, the air will cause objects to adhere to walls or move to areas with smaller air pressure. Winds are caused by differences in air pressure.

Air contains changing amounts of dust, pollen, and waste gases. Air pollution is often visible as a haze in the air. Sometimes the particles are large enough to be seen by the naked eye. It often has a distinctive odor.

It is important for children to understand concepts about air and water. These serve as a basis for understanding weather. The study of air may lead to development of the units, "Water" and/or "Weather." The teacher may wish to combine and relate activities from these three units.

Motivation for the Study

Suggested ways to initiate the topic are the following:

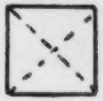
Make paper airplanes and fly them outside.

Set up a display of toys that are blown up.

Observe what is happening outside on a windy day.

Observe worms coming out of the ground to find air to breathe on a rainy day.

Concept	Performance Objectives
Air. A mixture of colorless gases. Air is invisible but can be felt. It surrounds Earth.	Given appropriate activities, the child will be able to infer that air is all around.
Wind. Wind is moving air.	The child will be able to describe wind and tell what it can do. The child will be able to infer that wind is moving air.

Materials Needed	Learning Activities
variety of objects plastic bag balloon pinwheel paper electric fan	The following are exploratory activities designed to use the senses to experience air. Ask children to wave their hands; catch air in a plastic bag; feel air being forced through the heaters in the room; feel air from an electric fan, a paper fan; fill a balloon with air and then feel the air as it is released; run fast; run with pinwheels. Discuss with children how they noticed air during each activity. Introduce the word "air." (Discuss with children that air is invisible. It can be felt, but not seen.)
streamers or spirals of paper, string radiator or source of heat	Hold or tie streamers or spirals above the heat source. Have children observe what happens. (Relate to what children have observed happening outside on a windy day--flags flying, clothes flapping on washline, or objects blowing.)
4" x 4" (10 x 10 cm) paper scissors string radiator or source of heat	Round off the paper into a circle. Start at one side and cut a line almost to the center of the circle. Take a piece of string. Make a knot at one end. Pull the string through the middle of the circle leaving about 12" (30 cm) of string. Hold circle above radiator. Ask: What happened to the circle of paper? (Hot air was pushed up and made the circle move.)
a windy day	Take children outside on a windy day to observe and feel the wind moving.
milkweed seeds	Take children outside to toss milkweed seeds into the air. Ask: What happened to the seeds?
paper pin kite sticks	Have children construct a pinwheel and attach it to a stick. Have them blow it; walk with it; run. Ask: What makes it move? 

Concept	Performance Objectives
Wind. (continued) Wind is moving air.	The child will be able to infer that wind is moving air.
Properties of Air. Air has certain characteristics or attributes.	
Volume. The amount of space taken up by an object. Air takes up space.	Given appropriate materials, the child will be able to demonstrate that air takes up space.

Materials Needed	Learning Activities
sheets of paper staples or tape	Have children fold paper in accordion pleats to make paper fans and fan their faces. (Gather the paper together at one end and fasten with tape or staples.) Ask: How does the fan make the wind feel on your faces?
book lightweight object, such as feather, piece of cotton or wool	Ask a child to put a book on the table and put the object near the side of the book that opens. Then have another child lift up one of the book's covers and let it drop. Ask: What happens to the object? Why? (Sudden closing of book creates moving air which causes the object to move.) Note: See page 227 for other activities on wind.
	#Discuss how the wind helps people, harms people. Note: See pages 142-145 for other activities regarding wind erosion.
empty thread spool or soap bubble ring/ bubble pipe bowl, water, detergent	Dip the ring into a bowl of detergent-water solution. Ask the children to blow some bubbles through the ring. Discuss what made the bubbles. (The bubbles help to confirm the fact that although air is invisible, we can feel it and see what it does.)
hot plate, hot pad water glass dish (heatproof)	Boil some water for several minutes. Have children observe the air bubbles.
candle jar matches	Remind the children that matches must be used only under adult supervision. Light the candle; then cover with a jar. Ask: What happens to the flame? (The flame goes out because the oxygen is burned up and carbon dioxide takes the place of oxygen.)
2 candles 1 jar asbestos pad/matches	Light both candles. Put a jar over one. Have children observe the length of burning time of each candle. Ask: Why did the one candle go out? Why did the other continue to burn?

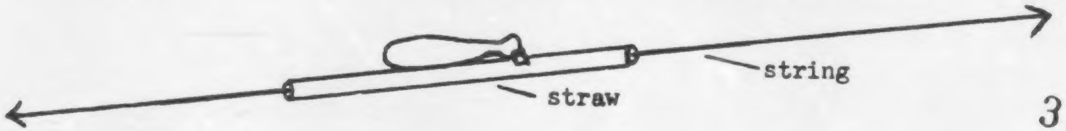
Concept	Performance Objectives
Volume. (continued) The amount of space taken up by an object. Air takes up space.	Given appropriate materials, the child will be able to demonstrate that air takes up space.

Materials Needed	Learning Activities
3 candles, same size 3 jars, various sizes asbestos pad, matches	Light each candle. Put a jar over each. Have children observe the length of burning time of each candle. Ask: Why is there a difference? Record what happened.
2 plants 1 jar	Cover one plant with a jar and leave another one uncovered. Give both plants equal amounts of sun and water. Ask: What happened to the covered plant? Discuss what plants need to live. (Plants use carbon dioxide and give off oxygen.)
plastic bottle with tight-fitting cap	Squeeze a plastic bottle. Have children observe how quickly the sides spring back into place. While the bottle is flattened, try to screw the cap on tightly. Squeeze the bottle. (The bottle will not spring back into shape until the cap is loosened to let air into the bottle.)
balloon radiator	Fill a balloon with air. Place over a radiator or other warm surface. Have children observe what happens.
balloons	Blow a balloon to capacity. Ask: What happened? Why?
a can with a small mouth a balloon some type of heat source pot holder bowl of ice	Be sure the can has nothing in it but air. Put the balloon over the mouth of the can. Set the can on the heat source and heat it. Ask: What happens to the balloon? (It blows up.) Why? (The air in the can gets warm. This causes the air to expand. The air takes up more room and blows up the balloon.) Put a pot holder around the can and pick it up. Put the can in a bowl of ice. Ask: What happened? (The balloon goes down. As the air cools off, it contracts.)
glass paper towel bucket of water (glass bowl)	Crumple the paper towel and place it in the bottom of the glass. With open side of glass down, immerse glass in water completely. (Be careful not to angle the glass.) Bring it out. Have children observe the paper towel. Ask: Why is it still dry? (There is air in the glass.) Lower it under water again; then tilt it. (The air goes out; water goes in and the paper gets wet.)

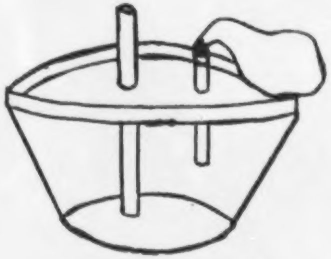
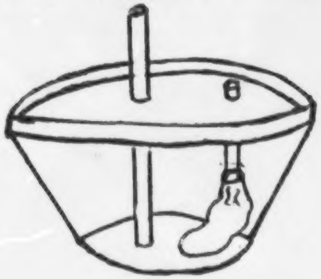
Concept	Performance Objectives
Volume. (continued) The amount of space taken up by an object. Air takes up space.	Given appropriate materials, the child will be able to demonstrate that air takes up space.
Weight. The force of attraction between an object and Earth. Air has weight.	Given appropriate materials, the child will be able to demonstrate that air has weight.
Pressure. The force of air pushing in all directions. Air has pressure.	Given appropriate materials, the child will be able to demonstrate that air has pressure.

Materials Needed	Learning Activities
2 glasses or 2 plastic tumblers aquarium water	Put a glass into the aquarium. Let it fill with water. Hold it mouth down. Push a second glass into the water mouth down. Let no water get into this glass. Now raise the water-filled glass above the second glass. Tilt the second glass. (Air bubbles escape from the tilted glass.)
air pump, scale basketball	Weigh a deflated basketball. Then pump it full of air. Weigh it again. Ask: What difference is there in the weight?
arm balance string balloons	Fill the balloons with the same amount of air. Tie a balloon to each end of the balance. Prick one of the balloons. Ask: What happens to the balloon? the balance? Why?
straw; glass; water	Have children suck on the straw. Ask: Why does the liquid go up the straw?
can of juice can opener paper cups	Punch a hole in one side or in the top of the can. Attempt to pour the juice. Ask: What happens? (The juice will not pour out.) Punch another hole in the can. (The air forces out the juice.) Have children taste the juice!
cranberry sauce can opener	Variation of the above. Use a can opener to remove the top of the can. Turn the can upside down and try to shake out the sauce. Punch a hole in the end of the can. Ask: What happens to the cranberry sauce? (The air forces out the sauce in one piece.)
streamer or a strip of paper 1" x 9" (2.5 x 23 cm)	Have children hold the paper at one end and pull it through the air. Then tell what happens to the paper. Have them move more rapidly; observe. (More air pushes up as the paper is moved more rapidly.)
paper	Have children hold the paper at one end, blow against the top of the paper and tell what happens. Then have them blow over the top of the paper and tell what happens. (Air over the paper pushes down with less force.)

Concept	Performance Objectives
Pressure. (continued) The force of air pushing in all directions. Air has pressure.	Given appropriate materials, the child will be able to demonstrate that air has pressure.

Materials Needed	Learning Activities
glass piece of cardboard	Fill the glass full of water. Place the cardboard over the top of the glass. Hold the cardboard and turn the glass upside down. Take hand away from cardboard. Have children observe what happens. Hold glass sideways; then hold glass upright and have a child try to blow off the cardboard.
hammer and nail pan of water tin can	Invert a tin can. Punch a hole in the bottom. Keep the tin can inverted; force the open end into a pan of water. Ask: What do you feel? (The jet of air comes through the hole.)
detergent, water, bowl hand beater or electric mixer egg whites, gelatin or whipping cream	Put the detergent into a bowl of water. Ask a child to beat with the beater until foam forms. Ask: Why does the appearance change after beating? (When demonstration is completed, mixture can be used for finger painting.) Variation: Follow same procedure with each of the foods. Use edibles for a tasting party following the demonstration.
handkerchief or square of cloth string toy or other object	#Make a parachute. Ask a child to tie a toy or other object to the strings. Have him roll it up and throw it up into the air. When the parachute opens, call attention to how the object comes down (slowly). Air pushes against the parachute. Ask: Why are parachutes used? By whom? (sky divers, medical workers, ranchers, smoke jumpers, and military)
cheesecloth milk bottle string/rubber band	Fold cheesecloth in half and tie over the mouth of the bottle. Fill the bottle with water; fill through the cheesecloth. Quickly turn the bottle upside down. (Water remains in the milk bottle. The air pushes up.) Ask children to infer what happened.
drinking straw balloon string, approximately 20'-30' (6-8 m) long	Attach a deflated balloon to the straw with tape. Draw a string through the straw. Have a child hold each end of the string. Blow up the balloon and release. (Air pressure from the balloon pushes the straw across the string.) 

Concept	Performance Objectives
Pressure. (continued) The force of air pushing in all directions. Air has pressure.	Given appropriate materials, the child will be able to demonstrate that air has pressure.
Interaction. Objects interact when they do something to each other.	
An Interaction of Air and Water. When water enters an object, air is pushed out.	The child will be able to demonstrate that air is in water and soil.

Materials Needed	Learning Activities
pop bottle water straw clay	Have a child fill a pop bottle with water; put a straw in it. Then have him place some clay around the straw and suck on the straw. Ask: Does the water come up? (No) What is wrong? (The clay keeps air away from the water.) Have him take away the clay and suck. Ask: What happens? (The water comes up.) Why? (Air presses down on the water and helps push it up the straw.)
$1\frac{1}{2}$" (4 cm) vinyl tubing balloon plastic container plastic cover for container (with two holes) red crayon plastic straw	Set up the container as shown in Figure 1. Blow into the straw. Record by drawing what happened. Reverse the balloon as shown in Figure 2. Blow the air; then suck it out. (When more air is added to a closed container, the pressure is increased. When air is removed from a closed container, the pressure is decreased.)  **Figure 1**  **Figure 2**
plastic containers water work tray small plastic cup sponge wool swatch pumice	Fill each container half full of water. Push the small cup into the water. Tip the cup after it is part way in the water so that the children can see the bubbles of air escape from the container. Have children test each of the three objects under water. Squeeze the sponge and force air out of it; submerge the piece of cloth by pressing down against the bottom of the container; drop the pumice into the water. Record what happened with each object.

Concept	Performance Objectives
An Interaction of Air and Water. (continued) When water enters an object, air is pushed out.	The child will be able to infer that air and water cannot occupy the same space at the same time.
An Interaction of Air and Objects. When air interacts with an object, it changes the shape of the object.	
Air. People use air for transportation and recreation.	The child will be able to state four ways people use air.

Materials Needed	Learning Activities
sponge water	Have a child put a sponge into the water; squeeze the sponge and tell what happens. (The air comes out of the sponge in bubbles.)
soil water pan	Have a child put some dry soil into a pan and pour water on the soil. Ask: What happens? (The water interacts with the air in the soil. The air comes out in bubbles.) Why do you think the air came out? Note: See related activities on pages 134-137.
porous rock jar of water	Have a child place the rock in a jar of water and tell what happens. (Air bubbles appear near the rock.)
porous materials, such as: lump of soil sugar lumps building brick cotton or wool bread/cake glass jars, warm water	Have a child put objects in the glass jars. Pour warm water over them and tell what happens. (Since warm water cannot hold as much air, the air leaves the porous objects and appears as tiny bubbles on the sides of the containers.)
plastic bag and tie book straw	Divide the children into pairs. Ask them to blow air into the bags. Then put a straw into the bags. Fasten with a plastic tie. Place a book on the bag. Ask: What do you feel escaping?
deflated balls air pump	Ask children to feel the deflated balls. Then pump them. Ask: What happens as air is pumped into the balls? Have children hold the balls to feel the air.
reference books study prints filmstrips	#On large index cards or on a chart, list questions similar to the suggestions below. Ask children to use reference materials and report their findings by telling, constructing, demonstrating, or writing. How is air helpful? How is air harmful? How does air help you to have fun? What forms of transportation use air to move them? What jobs and workers are involved in transportation?

Concept	Performance Objectives
Air. (continued) People use air for transportation and recreation.	The child will be able to state four ways air is helpful and harmful.
Air Pollution. Some air is unclean. It has particles of materials in it, sometimes large enough to be seen. It is often visible as a haze and sometimes has distinctive odors.	The child will be able to identify sources of air pollution.

Materials Needed	Learning Activities

study prints
magazines
books
filmstrips
films

#Provide reference materials for children. Ask them to find out how air is helpful and harmful to people--at home, at school, and in the community. Record information (written or pictures).

Home		School		Community	
Helpful	Harmful	Helpful	Harmful	Helpful	Harmful
dries hair dries clothes cleans carpet blows seeds blows cool air fills balloons	blows dirt into eyes & faces	heats & cools the school dries chalkboard cleans erasers	blows dirt into eyes stings faces blows away soil	dries ball field moves hydroplanes sails boats	destroys buildings destroys plants

#After chart is developed, a discussion may follow regarding the various workers involved.

#Discuss with children: What is air pollution? Is it natural? Man-made? Why is it harmful? How is polluted air different from fresh air? Contact a representative from the Environmental Protection Agency to explain ways of controlling pollution.

#Make a list of sources of air pollution: cars, buses, industry, generating of electric power, fires, and heating homes, schools, offices, and factories. Ask children to bring in pictures or newspaper accounts of air pollution.

paper
pencil

#Ask children to check their community to observe where the air appears clear and clean or smoky and hazy. Ask each child to keep a personal record similar to the one below. Note: Results will vary depending upon the locations in the community the children test for air pollution.

Place	What I Saw	What I Smelled	How I Felt

Concept	Performance Objectives
Air Pollution. (continued) Some air is unclean. It has particles of materials in it, sometimes large enough to be seen. It is often visible as a haze and sometimes has distinctive odors.	The child will be able to identify sources of air pollution.
	The child will be able to identify three ways pollutants get into the air.

Materials Needed	Learning Activities
data sheet	#Prepare a data sheet for children to test air pollution in their neighborhood.
material to be burned gallon jar matches water, sand	Note: This is a teacher demonstration. Burn a small amount of material in the schoolyard and in a gallon jar. Ask: What do you see? What is smoke? What do you think it is made of? Have children describe the color of the smoke in the jar. Ask: Is it easy to see through? What would it be like if the classroom were filled with smoke? How would your eyes feel?
dish of petroleum jelly chalkboard erasers piece of wood sandpaper	Put some petroleum jelly in a dish. Have children observe and record its appearance; mark the date. Place it in a location where there will be activity. Throughout the week, carry out activities near the dish, such as clapping the chalkboard erasers or sanding a piece of wood. After one week, have children describe the jelly and compare with earlier observations. Ask: How is this related to people breathing in particles similar to those caught in the dish?
checksheet, pencil	#Take children on a walk to check out air pollution in the neighborhood.
piece of gauze string or electrical tape	Note: This is a teacher demonstration. Tie or tape a piece of gauze over the exhaust pipe of the teacher's car. Start the car. Have children describe the gauze. Ask: If the gauze had not stopped the particles, where would they be? Do you think any particles escaped into the air through the gauze? Did the gauze stop the odors (gases)?
	#Interview workers with the Environmental Protection Agency and/or the Safety Lane regarding their work and air pollution.
	#Have children keep a record of the local smog count given on the TV weather reports.
	Have children write stories about air pollution--sources, evidence of, and ways to improve conditions. Have them make pictures showing what people can do to help prevent air pollution.

Concept	Performance Objectives
Atmosphere. The gaseous part of Earth that surrounds and mingles with the solid and liquid parts of Earth. The atmosphere is hundreds of miles high. It keeps the sun from making Earth too hot during the day and from getting too cold at night.	The child will be able to infer that air covers Earth.
	The child will be able to describe how the atmosphere affects Earth.

Materials Needed	Learning Activities
globe flat map	Based upon the previous activities, discuss with children all the places where they found air. Guide discussion to include places beyond immediate objects in the room. Ask: Is air around the school building? your home? Use the globe as a reference. Ask: Where would we find air? (Around hills/mountains/ponds/rivers/lakes/oceans)
	#Ask: Is there air in outer space where spaceships travel? (No. Children may suggest the kind of equipment they have observed astronauts use.) Note: See page 257 for a related activity.
	Discuss what would happen if there were no air. Most people take air for granted.
filmstrips study prints depicting layers of atmosphere	Discuss with children the layers and the height of the atmosphere. Explain that the higher the layer, the thinner the air until it reaches outer space where there is no atmosphere. Planes, rockets, and some Earth satellites travel within the limits of the atmosphere. Note: Not all primary children will be able to grasp this idea.
	Note: See pages 250-255 for related activities.
	Discuss the harmful effects that solar radiation can have on people's skin. Explain that if it were not for the atmosphere, the burns would be more severe. Note: See page 237 for a related activity.

Bibliography - Air

Adler, Irving and Ruth. Air. New York: John Day Company, 1962.

Bendick, Jeanne. The Wind. Chicago: Rand McNally, 1964.

Pine, Tillie S. and Joseph Levine. Air All Around. New York: McGraw-Hill Book Company, 1960.

Preston, Edna M. Air. Chicago: Follett Educational Corporation, 1966.

Mediography - Air

	Division of Resource Services A-V Number
Air: A First Film	1148
Air Pollution: A First Film	1274
The Air (Primary Science)	7272
Earth's Blanket of Air	7737
Finding Out About Land, Air, and Water	5728
Our Earth: Land, Water, and Air	7736

Introducing Weather (Aims Instructional Media)
5 filmstrips/5 cassettes

WATER

Rationale

From infancy on, children are fascinated by water and usually respond to it quickly. They have had many experiences with water, such as playing in it, washing in it, and swimming in it. Some have experienced moisture forming on the outside of the glass containing a cold drink, and clouded eyeglasses when the wearer comes indoors on a cold day.

Background for the Teacher

Water has many properties in common with air--colorless, odorless, and tasteless (in its pure phase). It is seldom found or used in its pure phase. Young children may have difficulty in understanding that water is really tasteless since they are accustomed to tasting water with chemicals for purification.

Water is one of the few material substances that exists in three natural phases: as a solid (ice), a liquid (water or rain), and a gas (water vapor). As a solid, water is usually called ice, although it may be called snow, frost, or hail. Due to changes in temperature, water is constantly changing from gas to liquid (condensation), from liquid to solid, and from liquid to gas (evaporation).

Evaporation is the means by which water gets into the air. Water is constantly evaporating. When energy (usually heat) is supplied to water, it turns from liquid to water vapor (gas). As the water vapor gives up heat, it is turned back to water. This continual giving up and taking on energy is the main cause for precipitation. The sun, the major source of energy, causes the water from bodies of water to change to water vapor.

Condensation is the opposite of evaporation. It is the process of changing water vapor (gas) to liquid. When the water vapor is cooled, the vapor changes to liquid (water). Warm air can hold more moisture than cold air. When air holds all the moisture it can, it is said to be saturated. If saturated air is cooled, it must lose some of its water in the form of precipitation.

Sufficient water supply and water pollution are very real problems confronting people today. Scientists are searching to find easy and inexpensive ways to reclaim used water or to change sea water into fresh water. It is imperative that people practice conservation of water in their daily lives. Organisms depend upon it for survival.

This unit is designed for children to use their senses to learn more about the nature and properties of water. They should begin to understand some predictive patterns. They will observe that some materials dissolve readily; others mix but do not dissolve; and others do not dissolve or mix. Attention is given to exploring the many ways people use water and the way it is stored and made available to people when they need it. The importance of water and the wise use of it are strongly emphasized.

Since air, water, and weather are interrelated, the teacher may wish to select some concepts and activities from the "Air" and "Weather" units as this topic is developed with the children.

Motivation for the Study

The following are suggestions for initiating the unit:

Observe the moisture in a terrarium.

Discuss current news items about water pollution.

Concept	Performance Objectives
Water. A colorless, tasteless, odorless liquid when it is in its pure phase.	The child will be able to state five places where water is found.
	Given a globe or flat map, the child will be able to identify areas of water.
	The child will be able to state five ways water is important to the daily lives of plants and animals.

Materials Needed	Learning Activities
chalkboard, chalk or chart paper	To begin to develop the topic, discuss with children where they have seen water. Make a list and continue to add to it as children think of other sources.
globe U.S./world maps	Have children observe how much of the surface of Earth is covered by water. Discuss with them the names of the sources of water (ocean, sea, river, lake, stream, and the like). Have them find some of these on the globe and/or map.
magazines films books filmstrips study prints	#Discuss with children how they use water. Begin a chart similar to the one below. Provide some reference materials. Ask children to find other ways people use and need water. Discuss the workers involved when appropriate; for example, firemen, street cleaners, nurserymen, farmers, and the like. **We Use Water To** take a bath drink put out fires clean streets (street sprinkler) move materials on boats beautify (fountains) cook food swim sail grow plants
2 plants water	Have children water one plant regularly, but not the other. Ask: What happens to the unwatered plant? What would happen to organisms if there were no rain?
plastic aquarium water, water plants fish, snails	Establish and maintain an aquarium.
reference materials: filmstrips, study prints, books, pictures (teacher's collection)	#An individual child or a small group may be interested in finding out how people get drinking water. Consider presenting this sequentially, for example, water shed collects moisture; water carried by rivers to reservoirs; reservoirs supply cities. Take children to visit the Water Works.

Concept	Performance Objectives
Properties of Water. Water has characteristics or attributes.	Given a sample of water, the child will be able to describe its observable properties.
Temperature. By changing the temperature, water can be changed to a different phase--solid, liquid, gas.	The child will be able to describe how water changes into ice when it becomes very cold.

Materials Needed | **Learning Activities**

for each child
distilled water
plastic tumblers

Pour some distilled water into the tumblers. Explain to the children that this water is very pure. Ask them to observe the water carefully. Guide observations with the following questions:

Hold the tumbler up to the light. What color is it?
Smell the water; taste it.
Feel it with your fingers.
How can you describe this water?

Discuss and record observations of the children. Example:

Water			
Color	Smell	Touch	Taste
no color colorless see-through transparent	no smell no odor odorless	runny moves	no taste

water
sunlight

Put drops of water in the sunlight. Move them slowly and gently to see what happens. Ask: What do you see when you put drops of water in the sunlight? (The sunlight must strike the drops in a certain way to have a prismatic effect. The drops act as a prism, breaking sunlight into the colors of the spectrum.)

ice tray
water
refrigerator

Pour water into an ice tray; discuss its appearance. Put in the freezer. After freezing, remove and discuss its appearance. Ask: What happened? What caused the change?

for each group:
plastic container
plastic tumbler
table salt
ice cubes

Put the ice cubes in the container. Pour in one or two cups of salt. Mix to distribute the salt. (Salt lowers the temperature of the ice in the container. This makes it possible for the mixture to absorb greater amounts of heat than the ice can absorb alone.) Put about $\frac{1}{2}$" (1 cm) of water in the plastic tumbler. Embed the tumbler in the container of ice and salt. Have children observe the tumbler for a few minutes and report changes as soon as they observe them.

Concept	Performance Objectives
Temperature. (continued) By changing the temperature, water can be changed to a different phase--solid, liquid, or gas.	The child will be able to predict what will happen to ice and water when each is subjected to a change in temperature.
Shape. Water takes the shape of the container it occupies. It has no shape of its own.	The child will be able to demonstrate a chosen observable property of water. The child will be able to predict the shape of chilled or frozen liquids.
Volume. The amount of space a material occupies.	The child will be able to demonstrate a chosen observable property of water.

Materials Needed	Learning Activities
ice cube pitcher of water plastic tumbler heat source pan	Have children look at the ice cube. Ask: What is the solid form of water called? (ice) Where do you find frozen shapes of water? (ice skating ponds, icicles, popsicles, icebergs, ice cubes) Show the children an ice cube. Pour water into the tumbler. Boil water in a pan. Ask: Are all of these water? How do you know? What form of water is in the ice cube? (solid) What form of water is in the glass? (liquid) What form escapes in the clouds above the pan? (gas)
bottles (different shapes) pitcher of water measuring cup	Have a child pour a cup of water into each bottle. Compare the shape of the water in each.
assortment of plastic containers or molds modeling clay variety of liquids	Have a child pour water or other liquids, such as milk or fruit juices, into molds. Place in freezer. Show children how to release the frozen solid from the molds by dipping them briefly into warm water. Help children realize that when liquids freeze, the solid has the same shape as the container in which the liquid is frozen.
gelatin, molds instant pudding	Have children make gelatin or instant pudding. Unmold and observe.
popsicle molds or small waxed drinking cups fruit punch sticks	#Make frozen popsicles. (If cups are used, remove popsicles from cups after they are frozen.) Discuss what happened. Eat! The teacher may wish to organize the children into groups for an experience in division of labor and assembly line production.
measuring cups pitcher water variety of containers (jars, bottles--large enough to hold at least one cup)	Have a child fill a measuring cup with water and pour one cup (237 ml) of water into each of three containers. Have children observe the containers. Ask: How much water is in each? Describe the shape of the water in each. Ask: Did the water take up space? (Be sure to emphasize that the same amount of water is in each container. Some children may have difficulty in understanding that the shape of the container does not affect the volume of the water. Some may believe the tall, narrow one holds more liquid than the wide, shallow one.)

Concept	Performance Objectives
Weight. The force of attraction between an object and Earth. Water has weight.	The child will be able to demonstrate a chosen observable property of water.
Cohesion. The force of attraction of like materials.	

Materials Needed	Learning Activities
water plastic tumblers spring scale with a platform	Have a child weigh a small tumbler and record the weight; then fill it with water. Ask: Does it feel lighter or heavier now? Have another child weigh the tumbler with water in it, record, and compare with the first finding. Pour out the water and have a child repeat the above procedure. (Be sure the tumbler is dry before weighing.) Compare results with the previous results.
variety of liquids: milk, water, salad oil, vinegar, starch, soda measuring cups spring scale with a platform paper towels plastic tumblers	Variation of previous activity: Discuss with children why it is important to use the same size measuring cup each time. (The volume of liquid and the measuring cup standardize the measurement.) Using similar procedure as before, ask children to weigh one cup of milk with an equal amount of water. Try the other liquids. (Be sure the children dry the cup each time they choose another liquid. As they weigh each liquid, help them to realize that they must compare equal volumes in order to compare the weights of a material.) Have children order the liquids (heaviest to lightest; lightest to heaviest).
empty filmstrip cans aquarium with water variety of liquids	Have a child fill one can with water; mark it "W." Fill each can with a different liquid, such as milk, vinegar, or salad oil. Put the lids on the cans. Have children place all the filled cans in the aquarium. Ask: What happens to each? Is the water lighter or heavier than most of the liquids?
for each group: plastic tumbler with water medicine dropper aluminum foil pans with cooking oil for each child: piece of wax paper small piece of blotting paper	Divide the children into groups. Demonstrate how to fill the medicine dropper with water. Have each child squeeze several drops of water on the wax paper and observe the drops. Ask questions similar to the following: Do all the drops of water have the same shape? What did you discover about the shapes and sizes of drops of water on your wax paper? (The smaller ones are more rounded.) What happens when you add another drop of water to the first drop? What happens when you make two small rounded drops go together? (They make a larger and flatter drop.) Do the drops stay together? What happens if you separate a larger, flatter drop into two smaller drops? (When the children roll some of the drops of water together, the drops stick together, making a larger drop.)

Concept	Performance Objectives
Interaction. When one object does something to another, interaction occurs.	
An Interaction of Objects and Water. Some objects float in water; others do not.	The child will be able to name three objects that float in water.
	Given a set of objects, the child will be able to classify those that float and those that do not float.

Materials Needed	Learning Activities
display area **magazines**	#Discuss with children the objects that are used to keep **afloat** in water (raft, life preservers, water wings, boat cushions, inflated tubes, and the like). Ask: Why do you think these objects keep people afloat? Who uses these? Why do they use these? Ask children to draw or cut from old magazines pictures of these objects.
for each group: aquarium with water empty filmstrip cans or empty plastic pill vials (with lids) assortment of liquids--milk, water, cola, molasses, vinegar, hand lotion, or shaving lotion scale	Have children put some liquid into each can or vial. Label each container regarding contents. Place in the aquarium. Have children observe and record the action of each (sinks, floats, floats just below the surface of water). Compare and discuss findings of each group. (There should be discrepancies in the reports since the amount of liquid that each child placed in the container will have varied.)
	Ask: Does anyone have an idea regarding why there is disagreement? (Some children may suggest that the amount of the material was not equal.) What could be done to make each container equal? (Some children may suggest to "fill the containers" or "to make them all even.") Have children repeat previous experiment. Record findings of each. Compare and discuss results. (Liquids that sink are heavier than water. Liquids that float above the water are lighter than water.) Children may be interested in weighing each container and checking the results against their recorded findings.
variety of objects: styrofoam cubes, rock, rubber bands, eraser, pencil, crayon, cork, nail, paper clip, toothpicks, or thread spools pan of water paper towels plastic container	Provide time throughout the day for individuals or small groups of children to test which objects will float and not float. Have them keep a personal record of their findings. Discuss and compare results.

Concept	Performance Objectives
An Interaction of Water and Materials. Absorption. Some materials have the ability to hold water.	
	Given a set of materials, the child will be able to predict those that will absorb water.
	Given a set of materials, the child will be able to classify those that absorb water and those that do not.

Materials Needed | **Learning Activities**

foil pan with water
dry sponge

Ask a child to touch a very dry sponge and describe how it feels. Ask him to place it in the foil pan with a small amount of water; describe what happens. Ask: What caused the change? (Encourage children to use the terms, "soaked up" and "became softer," as they discuss the sponge and the water interacting.)

for each group:
- paper towel
- tumbler with water

Cut a strip of paper towel; immerse one end in water. Ask: What is happening to the towel? What is your evidence of interaction? (The children should observe the rising mark of wetness on the towel.)

for each group:
- plastic tumbler with water
- tray of materials: blotting paper, felt, aluminum foil, vinyl, balloon, fabric, and ribbon
- paper for recording predictions and outcomes

Divide the children into groups. Have them identify the kinds of materials on the tray. Ask them to predict what they think will happen to each material when they put it into water. Record predictions; test each material. Have them record on a chart similar to the following what happened to each material.

Material	What We Predict	What Happened to the Material

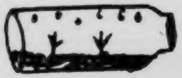
Discuss the children's findings from the preceding activity. Introduce the word "absorb." Ask: What materials will absorb water? Make a class chart similar to the following.

Materials That Absorb Water	Materials That Do Not Absorb Water

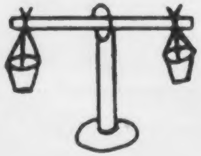
Concept	Performance Objectives
Absorption. (continued) Some materials have the ability to hold water.	Given a set of materials, the child will be able to classify those that absorb water and those that do not.
Solubility. Some materials have the ability to dissolve in water; others do not.	Given a set of materials, the child will be able to predict which materials will dissolve in water.
Water Pollution. Some substances make water unclean or impure.	The child will be able to identify three ways water is polluted.

Materials Needed	Learning Activities
cooking foods: cereals, rice, dried fruits hot plate, hot pad pan, spoon	Provide a cooking experience time at school or ask children to watch at home for examples of interaction of foods with water. Ask children to report findings to the class.
blotting paper water	Ask: What happens to water when you put it on a piece of blotting paper?
for each group: assortment of materials, teaspoon of salt, sugar, sand, oil, instant tea or coffee, milk, small piece of wood, soap, candy, chalk, rock, dried peas or beans, nail, paper clip empty plastic pill containers with lids or baby food jars with lids large jar	Have children pour an equal amount of water into each plastic container. Let each group choose the objects to place in the container. (Put a different material in each container.) Put on the lids. Label. Fill one container with water (to serve as the control).
	Have children check each container in about one hour. Ask: Was there any interaction? What is your evidence? (Some materials will dissolve; some will mix; others will settle out.)
	Keep the contents in the containers. About three days later, have each group open the containers; observe the contents, and describe any change. (Encourage children to look, smell, and feel the water, but not taste it.)
	Ask each group to pour the contents of the container into the large jar. Ask children to describe the water. Ask: Would you want to drink it? People need to care for water so that it is fit to drink. Ask: How can people help keep water sources free from litter?
	#Discuss with children why it is necessary to check on the purity of water before they drink it or cook with it. Discuss the workers involved with the purification of water.
	Relate the above to the pollution of water; discuss this problem. Ask children to bring in newspaper and magazine articles about water pollution.

Concept	Performance Objectives
Water Cycle. The natural continuous cycle of water as it changes from liquid to vapor and back to liquid.	The child will be able to explain the water cycle.
Evaporation. The process of changing a liquid to a gas is called evaporation.	The child will be able to demonstrate evaporation.

Materials Needed	Learning Activities
jar for building a terrarium soil, small plants 	Establish a terrarium and have children observe the mini-water cycle. (Moisture will evaporate from the soil and plants and accumulate at the top of the jar. When sufficient moisture has accumulated, droplets of water will fall back on the soil and plants.) Relate to the water cycle concept.
cloth or sponge water cardboard for fanning	On the chalkboard, ask a child to make two wet spots of the same size with the cloth or sponge and fan one spot with cardboard. Do not fan the other. Ask: Which dries first? Why? (Wind helps water to evaporate.)
2 bowls water measuring cup	Have a child put a cupful of water in each bowl and place one in sunlight, the other in the dark. Have children check after one hour, two hours, three hours, four hours. Ask: How much is left? Have children measure and record. Ask: What happened? Where did the water go?
heat source cloth, 2 pieces the same size water	Have a child wet both pieces of cloth; squeeze out as much water as possible. Then put one piece in a warm place; the other in a cool place. Have them look at both pieces every ten minutes until one of them is dry. Ask: Why did the piece in the warm place dry first? (Heat helps water evaporate.)
water cloth, 2 pieces alike	Have a child wet the pieces of cloth and squeeze out as much water as possible. Then spread one piece out on the table smooth and flat. Do not spread out the other piece. Ask: Which one dries first? Why does the water evaporate faster from the cloth that is spread out? (More of the cloth touched the air so the water could get into the air more easily.) Why do people spread out clothes on a clothesline?

Concept	Performance Objectives
Evaporation. (continued) The process of changing a liquid to a gas is called evaporation.	The child will be able to demonstrate evaporation.
Condensation. The process of changing water vapor (gas) to a liquid.	The child will be able to demonstrate condensation.

Materials Needed	Learning Activities
several plastic spray bottles water 	Fill a spray bottle with water. Push down on the part of the cap that moves. Have a child spray the water into the air. Ask: What did the water look like? How is it different from the water that was poured into the bottle? How long did the mist last? What happened to the mist? Have different children put their hands in the mist. Ask: What do you feel when you put your hand in the mist? Wave your wet hands quickly through the air. What do you feel when you wave your wet hands through the air? What makes your hands get dry?
paper cups paper clips (for unit of measure) assortment of foods piece of paper 	Put a sample of food in one cup. In the other cup; put the number of paper clips that each food weighs (as many clips needed to make balance equal). Have children record food and number of clips. Follow the same procedure with each food. Have a child put foods on a piece of paper and place in a warm area. Ask: What happens to the foods? After several days, have children weigh each piece of food again. Compare findings with those previously recorded. Guide discussion with questions similar to the following: What differences did you find between the first and second weighing? What do you think caused these differences? How do you know there was water in each of the foods? What happened to the water? Do some foods have more water in them than others? How do you know? How much water evaporated into the air from each piece of food (in terms of "paper clips")?
mirrors (unbreakable ones are desirable)	Distribute mirrors. Have children blow on them. Ask: What do you observe on the mirror? What made the small drops of water? Have all children blow on their hands. Ask: How does your breath feel on your hands? (warm) Do you think that the mirror is warmer or cooler than your breath? Why do you think it's cooler? warmer? Make mirrors available for children to work with on their own time.

Concept	Performance Objectives
Condensation. (continued) The process of changing water vapor (gas) to a liquid.	The child will be able to demonstrate condensation.
Water. Man uses the energy of moving water.	
Conservation. Preservation of water. People need to use water wisely.	The child will be able to state three ways people can help to conserve water.

Materials Needed	Learning Activities
for each group or child: plastic tumblers ice water	Have children put water into each plastic tumbler and feel the outside of the tumbler. (It should feel dry.) Ask a child in each group to put ice cubes into each tumbler and observe what happens. Ask: Why do the drops of moisture begin to appear on the outside of the glass? Have children feel the drops on the outside of the tumbler. Ask: What is the air like around the glass? Is there water vapor in the air? How do you know? Does the air get cooler in the glass? How do you know? (This should lead children to discover that a cool surface brings water vapor out of the air, forming drops of water.) Have you ever observed dew on grass? (Relate to dew which is formed this way.)
pictures of water wheels reference materials *The Magic of Water* (for suggestions to build a water wheel model)	Ask: How does water feel when it runs full force from a faucet or the nozzle of a garden hose? (The weight of water causes it to strike with some force.) #Some children may be interested in finding out about water wheels. They may want to consider some of the following: kinds of water wheels the different kinds of work of water wheels and related jobs involved ways water wheels are used today countries that still use water wheels to grind grain a model of a water wheel.
	Have children keep a record of ways they see water being wasted at school and at home (dripping faucet; forgetting to turn off faucets, drinking fountains or showers; taking more water than is needed; letting the hose run; and the like). Discuss specific ways they can help to correct this waste.
dripping faucet measuring cup paper, pencil	If there is a dripping faucet in the classroom or if children know of one at home, suggest they keep a record of how much water is wasted. Ask a child to put a measuring cup under the faucet to catch the wasted water; record the time. Measure the amount of water wasted after a given time. Discuss how much would be wasted in one day, one week, one year, and what could be done about it.

Concept	Performance Objectives
Conservation. (continued) Preservation of water. People need to use water wisely.	The child will be able to state three ways people can help to conserve water.

Materials Needed	Learning Activities
paper, pencil	Some children may be interested in making a survey of the faucets throughout the school to see whether or not they drip. They may wish to report their findings to the class, principal, and custodian. Others may want to make a survey in their homes.
poster-size paper	Have children make posters on ways to conserve water. Display throughout the school.

Bibliography - Water

Adler, Irving and Ruth. *Rivers*. New York: John Day Company, 1961.

Branley, Franklyn M. *Floating and Sinking*. New York: Thomas Y. Crowell Company, 1967.

Hagaman, Adeline. *What Is Water?*. Chicago: Benefic Press, 1961.

Meyer, Jerome. *Water at Work*. New York: World Publishers, 1963.

Miller, Patricia K. and Iran Seligman. *At Home on the Ice*. New York: Holt, Rinehart and Winston, Inc., 1963.

Riedman, Sarah. *Water for People*. New York: Abelard-Schuman, 1961.

Schloat, G. Warren, Jr. *The Magic of Water*. New York: Charles Scribner's Sons, 1955.

Smith, F. C. *First Book of Water*. New York: Franklin Watts, 1959.

Tressett, Alvin. *Hide and Seek Fog*. New York: Lothrop, Lee, and Shepard Company, Inc., 1965.

Mediography - Water

	Division of Resource Services A-V Number
Finding Out About the Clouds (Basic Primary Science - Group II)	5734
Finding Out About Land, Air, and Water (Basic Primary Science - Group I)	5728
I Like Water	928
Let's Find Out About the Ocean (Science - Let's Find Out)	10678
Let's Find Out About Water (Science - Let's Find Out)	10672
Our Big Ocean	1365
Our Earth: Land, Water, and Air (Introduction to Our Earth and Sun)	7736
The River: A First Film	935
Water Pollution: A First Film	1272
Wonders in a Country Stream	1569

Stepping Into Science Book Bag (Children's Press)
No. 07344-3 Things to Do With Water

WEATHER

Rationale

Most primary children have some knowledge of weather before they enter school. They have experienced the influence of weather on their activities--rainy "in" days, outdoor fun on snowy days, or painful sunburns. They are aware that weather affects how they dress because adults constantly remind them to wear appropriate clothing. Weather forecasts on television are a part of their daily lives. Many children have lived in other parts of the country and have experienced a variety of weather conditions.

Background for the Teacher

Weather is the condition of the atmosphere at a particular time and place. The elements usually observed to forecast weather are precipitation, clouds, temperature, wind, humidity, pressure, and visibility.

In the primary science program, the following weather elements are emphasized: precipitation, cloudiness, air temperature, and wind. The science program, 4-6, builds upon these and extends the child's learnings to other weather elements.

When describing weather, it is necessary to describe changes in the conditions, as well as the conditions themselves. The conditions usually include the temperature of the air, the air pressure, the amount of moisture in the air (humidity), and the direction and speed of the wind. When meteorologists predict the weather, they look at the kind of air masses that are moving across Earth. These air masses are responsible for changes in the weather.

Weather can be considered a system of air, water, and heat, and the interaction of these produces the variations of weather. The water cycle is the result of this interaction.

Precipitation refers to forms of moisture that fall from the atmosphere to the earth. Rain, sleet, snow, and hail are forms of precipitation.

Rain is one of the most important of all weather phenomena since it provides most of the moisture necessary for living organisms. Droplets of water in clouds are so small that a slight movement of air is enough to keep them floating in the air. If the droplets unite or increase to form drops large enough to fall in spite of rising air currents in the cloud, they fall to the earth as rain.

If condensation takes place below the freezing point of water (32° Fahrenheit; 0° Celsius), ice crystals are formed. If these crystals unite, snow may fall. Snow is formed by condensation directly from water vapor to ice crystals. Every snow crystal has six sides. No two snowflakes are exactly alike.

Sleet falls in small pellets and is formed when water vapor condenses on particles such as dust or ice.

Hail occurs only during thunderstorms when there are very strong ascending and descending currents of air. Size of hailstones varies from small to larger than hens' eggs.

Several kinds of wind storms are mentioned in this section. A cyclone is any mass of air that moves spirally around a center of low pressure. Cyclones usually bring stormy or cloudy weather. They are beneficial because they bring general weather changes and invigorating effects of changes in temperature and humidity, such as after a hot, dry spell.

Hurricanes and tornadoes are special kinds of cyclones which are very destructive. Hurricanes are sometimes called tropical cyclones or typhoons. They originate over water, but often move inland. Wind power may be from 75-200 mph (120-322 km).

Tornadoes are the smallest storms, but the most violent. The majority occur between the Rocky Mountains and the Appalachians; however, they have been reported elsewhere. A tornado consists of a mass of air whirling with great speed around a center of low pressure. Wind velocity has been estimated to be in the area of 500 mph (805 km). The most striking property of a tornado is its funnel-shaped cloud. Whenever this funnel touches Earth, havoc and destruction take place. People in Cincinnati have experienced the destruction of tornadoes. The roar of a tornado has been described as resembling a hundred jets or train whistles.

Meteorologists issue a tornado watch or tornado warning over television or radio. A tornado watch is a possibility of a tornado. It indicates that there could be a tornado within a broad area (several hundred square miles); the conditions are favorable for tornadoes to form. A tornado warning is a reality. It means a tornado has been sighted within a given area (a smaller area than in a watch) either by radar, trained weather observers, or other persons. A warning indicates there is potential danger.

Clouds are usually formed by the expansion and cooling of rising masses of air. Water is continuously evaporating from bodies of water on the surface of Earth. When water evaporates, it cannot be seen (water vapor). When the temperature of air is lowered sufficiently, the water vapor condenses into fine droplets. These droplets are so small and light that air currents keep them aloft. They often collect in large enough quantities to form clouds or fog in the air. Clouds and fog are made up of condensed water vapor. The main types of clouds are the following:

Fairweather:
  Cirrus - high, white, wispy
  Cumulus - white, fluffy, flat bases

Badweather:
  Stratus - low sheets
  Nimbostratus - dark gray, rather formless

In order to observe weather conditions, make comparisons, and note weather patterns, it is necessary to provide children with a variety of ways to keep records. The five-year-old can begin with a simple pictorial record. However, as children develop intellectually, the teacher must be sure to introduce more demanding ways of record keeping. A variety of charts for recording weather has been included. They are arranged from simple to complex.

Temperature is a very basic concept, not only in science, but in everyday life. Primary children need to learn to read temperature expressed as the number of units (degrees) on a scale. It is also useful for children to interpret a temperature reading in terms of "hot" or "cold" and relate a given temperature to safety or comfort. To enable them to do this, they must have a variety of experiences in measuring temperatures with thermometers. The following are illustrative examples:

the temperature of foods
the normal temperature of the body
the temperature when people have a fever
the temperature that indicates substances
  may be dangerous to handle.

Five- and six-year-old children do not need knowledge of whole numbers before they can read a thermometer. The teacher can color code the scale by placing strips of blue, yellow, and red paper along the tube of the thermometer. Children can read the temperature by "color" rather than degrees. The color serves as a common reference point which can be interpreted and communicated to others.

As children gain knowledge of whole numbers, they must be taught how to read a thermometer and to report the temperature more precisely. While they still see applications of the Fahrenheit scale, the teacher is encouraged to have children use the Celsius scale. Children are not to make conversions from one system to another; however, it is valuable to make comparisons between both systems.

Freezing Point of Water	32° F	0° C
Boiling Point of Water	212° F	100° C
Body Temperature	98.6° F	37° C

When children work with thermometers, they should be instructed to hold them at the top, never by the bulb unless specifically directed to do so. Body heat affects the temperature indicator of a thermometer.

Rain gauges are introduced in this unit. Water should be at exact intervals so children learn how to read the gauge. Then the water level should be changed to give practice reading between the marks on the gauge. If possible, it is desirable to keep a rain gauge in a location where it will not be disturbed.

Simple wind vanes are also introduced as a weather instrument. If the children wish to check wind speed, the chart below may be helpful.

Kind of Wind	Miles per Hour (Approx.)	Kilometers (Approx.)	Description
Calm	0	0	Smoke rises straight up.
Gentle Wind	10	6	Leaves & small twigs move.
Fresh Wind	20	12.5	Small trees begin to move back & forth.
Moderate Gale	35	22	Whole trees move back & forth.
Strong Gale	50	31	Tree branches break.
Whole Gale	60	37.5	Trees are uprooted.
Storm	70	44	Great damage is done.
Hurricane	Above 75	Above 75	Houses are destroyed.

This topic is designed so that primary children will observe, describe, record, and interpret weather conditions and the changes that occur. Application to daily lives is also stressed. It is necessary to continue the recording over a long period of time. The teacher may wish to develop another topic concurrently.

Motivation for the Study

The following may serve as springboards for motivating study of the topic:

Drastic changes in the weather in Cincinnati.

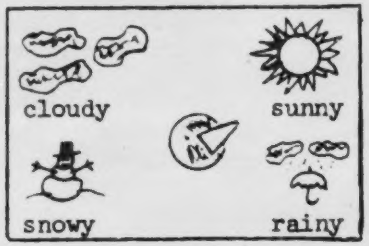
Discussion of the seasons and the kind of weather normally expected in each season.

Television and newspaper reports of severe wind or water damage.

Cincinnati's temperature range gives children opportunity to record and compare wide variables

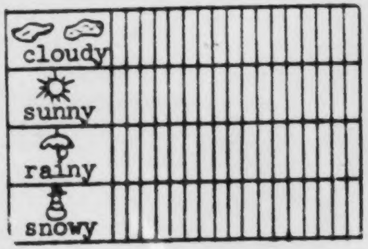
Concept	Performance Objectives
Weather. The condition of the air as to temperature, wind, precipitation, air pressure, humidity, and clouds.	Given a weather chart, the child will be able to record weather conditions by using the chart.
	Given appropriate materials, the child will be able to keep a record of the weather conditions.
	Given a weather chart, the child will be able to record the weather conditions by demonstrating the use of the chart.

Materials Needed	Learning Activities

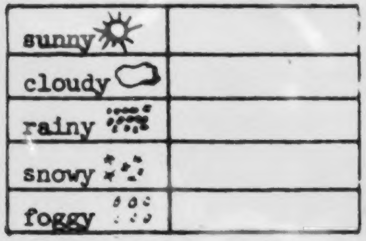


Depending on past experiences of the children, this chart may be the first experience with symbolism. If so, the teacher may wish to let the chart evolve with the weather; for example, on a rainy day, ask children to observe the weather and select a picture to represent the rain. Then a child turns the dial to the appropriate picture. Do the same as other kinds of weather occur.

#The children should observe and describe the weather conditions daily and set the dial. Discuss the occupation of the meteorologist.



This chart utilizes the bar graph. Children should observe the weather. One child sets the dial; another colors in one space that corresponds to the weather. Keep track of the weather for one month. At the end of the month, count the number of days of each kind of weather. Compare.

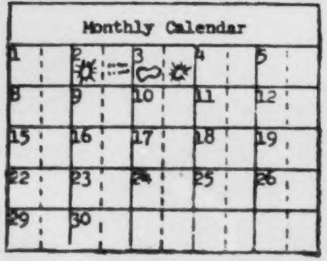


outside thermometer
cardboard thermometer

Keep a record of weather for one week; one month. Make a weather chart with symbols for recording sunny, cloudy, rainy, snowy, foggy, and windy. Have one child record the daily weather conditions on the wall chart.

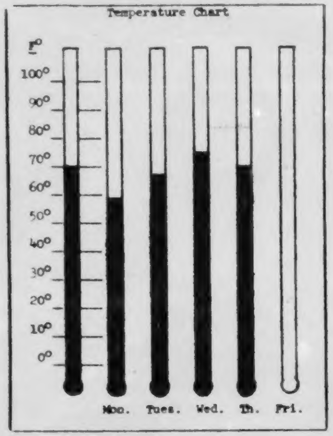
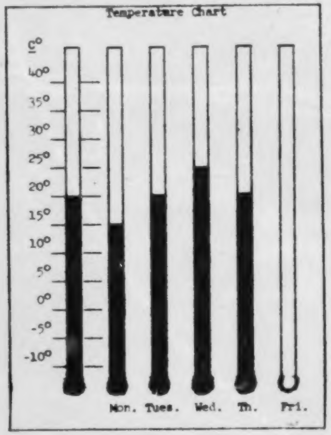
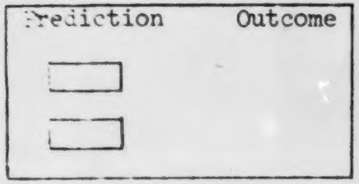
Two children working as partners read the outside thermometer, set the cardboard thermometer to match, and record the temperature on the chart.

monthly calendar
weather pictures



Have children draw pictures depicting weather conditions. Pin up each day. Show the wind factor through the smoke coming out of the chimney. Draw a dotted vertical line in each square to indicate weather changes during the day. Or have each child record on an individual weather chart.

Concept	Performance Objectives
Weather. (continued) The condition of the air as to temperature, wind, precipitation, air pressure, humidity, and clouds.	Given two thermometers (indoor and outdoor), the child will be able to read the temperature and compare.
	Given a thermometer and a five-day temperature chart, the child will be able to interpret the findings.
	Given a weather prediction and the outcome for a given day, the child will be able to explain each.

Materials Needed	Learning Activities
2 thermometers	Fasten an outdoor thermometer outside the window where children can read it easily. Hang an indoor thermometer in the room. Have children record and compare the temperatures over a sustained period of time.
5-day temperature chart (Both Fahrenheit and Celsius are given as examples.) outdoor thermometer	Each day have children read the outdoor thermometer and set the indoor thermometer to match. At the end of a five-day period, make comparisons, such as highest temperature, lowest temperature, trends.  
weather reports from newspaper  	Cut out weather reports from the daily newspapers. On a chart, have children post forecast under Prediction, then observe and record the actual weather for the day under Outcome. Compare the outcome with the forecast.

Concept	Performance Objectives
Weather. (continued) The condition of the air as to temperature, wind, precipitation, air pressure, humidity, and clouds.	Given a weather chart with recorded weather data, the child will be able to interpret the symbols.
	Given descriptions of specific weather conditions, the child will be able to match clothing with each type of description.

Materials Needed

Learning Activities

Our Weather Chart

Day Date	Mon.	Tues.	Wed.	Th.	Fri.	Mon.	Tues.	Wed.
cloudiness	◐							
wind	✓							
temperature	50°C							
other								

Note: When the chart is made, it should be extended to include at least 3 weeks.

#Have children observe the weather man on T.V. Use his forecast and observations to build a similar chart.

This chart introduces the idea of estimating cloudiness. The amount of cloudiness is recorded rather than the kind of clouds. Suggested symbols:

○ clear; no clouds

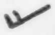
◕ mostly cloudy; more than half the sky is covered

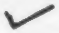
◐ partly cloudy; less than half the sky is covered

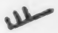
● overcast; no blue sky can be observed

An estimation of wind speed is also included. Wind arrows with barbs on the shaft may be used to show wind speed.

calm; no movement

 windy; tree limbs moving

 breezy; leaves moving

 very windy; tree trunk bending

The children may wish to devise other symbols to represent additional weather conditions, such as thunderstorm, fog, or smog.

As the children analyze the data, guide them to discover certain patterns that are significant; such as, freezing temperature and snow often occur together; temperature must usually fall to about 32° F or 0° C before it snows; rain and overcast skies usually occur together.

swatches of wool, vinyl, cotton, polyester
paper

#Have children make a scrapbook of clothes that are suitable for different kinds of weather--sunny, rainy, snowy.

cardboard thermometer
wall weather chart
sources for pictures

Use the weather chart. Discuss with the children what kind of outdoor activities they would enjoy. Ask: What kind of clothing would you need to wear? On the cardboard thermometer, paste pictures of appropriate clothing for a span of corresponding degrees.

Concept	Performance Objectives
Weather. (continued) The condition of the air as to temperature, wind, precipitation, air pressure, humidity, and clouds.	Given weather charts, the child will be able to compare Cincinnati's weather pattern with weather patterns in other parts of the world.
Water Cycle. The natural continuous cycle of water as it changes from liquid to vapor and back to liquid.	The child will be able to explain the water cycle.
Evaporation. The process of changing a liquid to a gas is called evaporation.	The child will be able to demonstrate evaporation.

Materials Needed	Learning Activities
individual or wall weather charts almanacs	If the class is corresponding with children in another part of the United States or in another country, exchange weather charts. Compare the differences between the two geographic locations. Or consult almanacs and compare the information.
	#Have children check the newspaper daily; keep a record of weather in other countries. Ask: How does the forecast get in the newspaper? What jobs are involved?
transparency of water cycle overhead projector	Put the transparency on the stage of the overhead and discuss with the children what is happening. Explain that the travel of water is called the water cycle. The following may serve as guidelines for questioning. What kind of weather is shown? Where is the rain coming from? Where will the rain go? What will happen to the rain when it lands on the earth? (Some will soak into the ground; some will evaporate into the air; some will run off into the lakes or rivers or streams.) What will happen at some later time? Note: See additional activities on water cycle, pages 199, 201, and 203.
water sponge chalkboard	Rub a wet sponge over the chalkboard. Describe. (Note change in color.) Ask: Where does the water go? (As it evaporates, it goes into the air as water vapor.)
chalkboard sponge, water foil plate	Wash chalkboard with sponge and water. Put the plate over a wet spot. Let the board dry. Take off the plate. Have children observe and describe the board where the plate was held.
2 pans of water source of heat	Set a shallow pan of water in the sun or near a heater. Set a similar pan in a cooler place. Ask: What happens to the water? Which evaporates faster? Why?

Concept	Performance Objectives
Evaporation. (continued) The process of changing a liquid to a gas is called evaporation.	The child will be able to demonstrate evaporation.
Condensation. The process of changing a gas to a liquid is called condensation.	The child will be able to demonstrate condensation.
Dew. Small drops of water form on the surface of cool objects.	The child will be able to identify dew.

Materials Needed	Learning Activities
water glass jar marking pen	Fill a quart jar 2/3 full of water. Let the children use a marking pen to record the level in the jar. Measure and record daily until all the water evaporates.
2 jars (1 wide mouth, 1 narrow) water	Fill each jar 2/3 full of water. Put jars in the same place. Mark the level of each jar. Compare the rate of evaporation in each of the jars. Ask: Which evaporates more quickly? Why? Note: See additional activities on evaporation, pages 199 and 201.
ice thermometer plastic tumbler water	Put warm water into the plastic tumbler. Measure the temperature; record. Gradually add ice to cool the water. Ask: What happens to the outside of the tumbler? (Water droplets begin to form.) Where does the water on the outside of the tumbler come from? When water droplets form on the outside of the container, measure the temperature. Compare with previous finding.
water dropper plastic jars with clear plastic covers (or baby food jars inverted) handlens	Divide the children into groups. Give each group a jar and a cover. Put one drop of water into the bottom of each jar. Have children cover the jars tightly. Record the time. Ask: How do the sides and top of the jar feel? (Dry.) Have each group draw how the jar looks and the location of the drop of water. Place the jars on a warm heater. Have children watch the jars for interaction. When this occurs, have them observe the interaction more closely with the handlens. (At the top of the jar, they will see the "mist" as the water droplets form.) When all the water has evaporated from the bottom of the jar, record the time. Draw the condensed water drops in the new location. Note: See additional activities on condensation, pages 201 and 203.
2 plastic tumblers ice cubes water	Have children place ice cubes in one tumbler. Pour the same amount of water in each tumbler. Ask: What happens to the outside of the tumblers as water is added? (Drops of water appear on the outside of the tumbler with the ice water.) What does this show? (condensation) Where have you observed dew?

Concept	Performance Objectives
Frost. Water condenses directly into ice crystals on surfaces.	The child will be able to identify frost.
Fog. Fine particles of condensed water vapor suspended in the air near ground level.	The child will be able to identify fog.
Cloud. Fine particles of condensed water vapor suspended in the air.	
	The child will be able to observe the condition of the sky and predict the probability of rain.

Materials Needed	Learning Activities
ice a tin can	Have children feel the outside of an empty tin can. (dry) Fill the can with ice. Have them feel and observe the interaction on the outside of the tin can. Ask: What happened to the can? Where have you observed frost?
ice cubes bottle with narrow mouth hot water	Pour a small amount of hot water into the bottle. Have a child place an ice cube over the opening of the bottle. Observe and describe the interaction. (When a cloud forms, relate this to fog.) Ask: Have you ever walked in a fog (a cloud near Earth)? Have children describe their experiences with fog, such as how it felt on the skin; how it affected their ability to see; what drivers did.
water hot pad hot plate tea kettle	Place a tea kettle on the hot plate. When the water boils, have children watch the spout of the kettle. Ask: What is forming? (The water changes into "clouds" when it is heated.) Is there a space between the spout and the cloud? What is it? (Water goes into the air as water vapor when it is heated. This is a simulation; relate to the water cycle and real clouds.)
reference materials	#Discuss with children the importance of clouds to people; for example, provide rain, give relief from heat of sun, studied by meteorologists to predict the weather.
study prints of main types of clouds additional reference materials	For children who want to know more about weather, provide reference materials for them to find out information related to the following: #What do the major clouds look like and what kinds of weather do they bring? What people need this information in their work? #What is cloud-seeding? Who seeds the clouds? What is lightning? Why is thunder heard after seeing a flash of lightning? How can you tell whether the lightning is near or far away?

Concept	Performance Objectives
Precipitation. Water that falls to the ground from clouds.	
Rain. Droplets of liquid water that fall to Earth.	The child will be able to state properties of rain.
	Given a rain gauge and rainfall, the child will be able to compute the amount of rainfall.

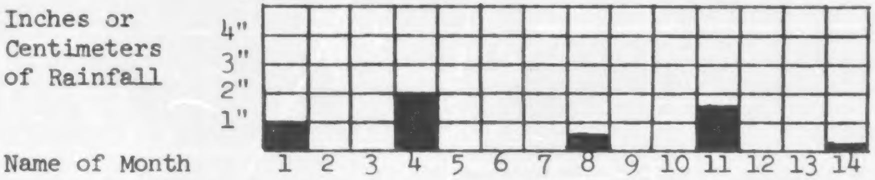
<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td>plastic tumblers, each containing one of the following: water, glycerin, white vinegar, and oil
containers of rain for each group
tissue per child
checksheet for each child</td><td>Have children label each tumbler. Ask: What is rain? (Most will say "water.") How can you be sure? Divide children into groups; show them the tumblers of liquids, but conceal the labels. Ask: Can you tell by looking which one is water? Ask children to dip a finger in one liquid and check the following worksheet; record properties by observing, feeling, and smelling. To help them make a comparison with rain, ask them to dip another finger in the rain container. Be sure they use the tissues to wipe their fingers before testing each liquid.

(These tests are not sufficient to prove that rain is water, but the experience should permit children to infer that rain is water.)

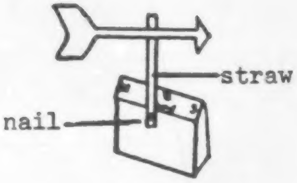
Repeat this procedure for the other liquids.

<table>
<tr><th></th><th>Oil</th><th>Vinegar</th><th>Glycerin</th><th>Water</th></tr>
<tr><td>Rain looks like</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Rain smells like</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Rain feels like</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>hot plate, hot pad
shallow pan
pitcher of ice cubes</td><td>Heat a shallow pan of water over a burner. When the steam begins to rise, hold a pitcher containing some ice cubes over the steam. Have children observe the interaction. Ask: What happened? (Droplets formed.) Relate to rain.</td></tr>
<tr><td>hot plate, hot pad
tea kettle with spout
cool, dry, empty bottle</td><td>Have a child put half a glass of water in the tea kettle. Boil the water. When steam comes out of the spout, place the dry, cool bottle over the spout. Have children observe the interaction. (Small puffs of vapor stick together to form drops of water. As the drops get larger, they will roll down the side of the bottle.)</td></tr>
<tr><td>glass, ruler
rainy day</td><td>On a rainy day, put a glass outside. When it stops raining, measure the rain water in the glass.</td></tr>
</table>

Concept	Performance Objectives
Rain. (continued) Droplets of liquid water that fall to Earth.	Given a rain gauge and rainfall, the child will be able to compute the amount of rainfall.
Snow. Ice crystals, usually six-sided.	
Hail. Sphere-like lumps made of layers of ice that fall to Earth.	

Materials Needed	Learning Activities
rain gauge for each group water tokio 1" square paper or centimeter paper rainy day	Divide the children into groups. Give one rain gauge to each group. Pour water into the gauge; let the children practice reading it. Decide where to put the rain gauges so they can catch the true rainfall. (If children suggest places, such as under a tree or on the window sill, discuss whether the gauge would be collecting less under the tree and more if it is under the eaves of the roof.)
	#Keep a record of rainfall. Ask: Who uses this in their work?
tokio paper or centimeter paper	
	On a rainy day, place the gauges outside; measure the level of rain in each.
snowy day handlens pieces of velvet	On a snowy day, take children outdoors to try to catch snowflakes on the velvet or on coats. (They need to use the handlens quickly to observe the various shapes of the snowflakes.)
ruler	After a snowfall, have children measure the snow; record the amount on a chart.
rain gauge or can	Turn the gauge upside down; lightly press into the snow. Carefully keep the snow inside; turn the gauge right side up. Mark the depth of the snow immediately. Bring the gauge inside. After the snow has melted, measure the depth of the liquid. Compare the two measurements. (The rule-of-thumb ratio, 10" (25.5 cm) of snow equal 1" (2.5 cm) of water, will vary depending on whether the snow is powdery and dry or heavy and wet.)
	Ask. When have you observed hail? What happens when you bring a hailstone indoors?

Concept	Performance Objectives
Wind. Mass of moving air.	
	Given a wind vane and a windy day, the child will be able to determine the direction of the wind.
Cyclone. Wind storm accompanied by rain. Hurricane or Typhoon. Tropical cyclone storm of great violence.	The child will be able to describe the various wind storms.

Materials Needed	Learning Activities
book feather, piece of cotton or wool	Have a child put a book on the table. Put a feather or a piece of cotton or wool near the side of the book that opens. Lift up one of the book's covers and let it drop. Ask: What happens to the feather or piece of cloth? Why? (Sudden closing of the book creates a mini-wind which causes feather or material to move.)
	Note: See additional activities on wind, pages 163 and 165.
cardboard, nail plastic straw block of wood  	#Make a wind vane from heavy cardboard. Construct two arrows; make the tails wider than the points. Place the plastic straw between the arrows, closer to the point of the arrows. Staple arrows together. Place the nail through the straw. Fasten the nail to a block of wood. Take outdoors. (The wind pushes the heavy tail away; the arrow points into the wind.) Winds are named for the directions from which they come. Observe the position of the arrow. Directions, N., S., E., W., may be written on the block. Record wind direction daily; observe type of weather resulting. Ask: In what types of work would this be beneficial? (pilot/control tower--wind sock; leisure sailboats and small fishing boats with sails)
	Have children check wind speed and changes throughout the school day. Keep a comparison chart.
	Note: See Teacher Background for suggested wind speed and description.
newspapers magazines	Have children cut out pictures about hurricane and typhoon occurrences.
reference books, study prints, filmstrips, maps	On index cards or on a chart, list questions (see suggestions below). Ask children to use the materials listed or other available resources and report their findings by telling, constructing, demonstrating, drawing, or writing. What is a typhoon? What is a hurricane? What is a cyclone? What is a tornado? In what part of the world do these usually occur?

Concept	Performance Objectives
Tornado. Most violent storm; very rapidly moving funnel-shaped wind.	The child will be able to state the difference between a tornado watch and a tornado warning.
Weather. People are affected by the weather. It helps and harms.	The child will be able to state three ways weather helps; harms.
Meteorologist. A scientist who studies and forecasts the weather.	The child will be able to explain the work of a meteorologist.

<table>
<tr><th>Materials Needed</th><th>Learning Activities</th></tr>
<tr><td></td><td>Discuss the difference between a tornado watch and a tornado warning. (See Teacher Background.) Ask: What precautions should be taken if a tornado warning is in effect? Why do some people carry insurance on property for damage done by tornadoes?</td></tr>
<tr><td>newspapers
magazines</td><td>Have children cut out pictures about tornado damage.</td></tr>
<tr><td>study prints, magazines, books, filmstrips, films, slides</td><td>#Ask: How is the weather helpful to people? Harmful? Have children bring in pictures from magazines and newspapers or draw pictures to illustrate. Combine on a chart. Ask: What paid and volunteer workers are involved?
<table>
<tr><th>Helpful</th><th>Harmful</th></tr>
<tr><td>sled riding (snow)</td><td>causes fires (lightning)</td></tr>
<tr><td>cleans plant leaves (rain)</td><td>uproots trees (wind)</td></tr>
<tr><td>flies kites (wind)</td><td>breaks branches (ice storm)</td></tr>
<tr><td></td><td>causes droughts</td></tr>
<tr><td></td><td>causes floods</td></tr>
</table>
</td></tr>
<tr><td></td><td>#Ask: How do weather conditions affect the various occupations of people? (If winter has little snowfall, farmers are concerned because immature plants are left exposed to severe cold of winter. Cities spend much money on snow removal. Ice or heavy snowfall interferes with transporting goods and people by air, rail, and road. Severe ice causes power outages and damage to people's homes.)</td></tr>
<tr><td></td><td>#Interview a local meteorologist.</td></tr>
</table>

Concept	Performance Objectives
Meteorologist. (continued) A scientist who studies and forecasts the weather.	The child will be able to explain the work of a meteorologist.

Materials Needed	Learning Activities
reference materials	#Children who have facility in reading may be interested in finding biographical information on some of the following people and their contributions to weather forecasting. G. D. Fahrenheit - thermometer Anders Celsius - thermometer James Pollard Espy - laid basis of the weather bureau Dr. John Lining - developed scientific instruments to observe weather Dr. Francis Reichelderfer - chief national weather forecaster Benjamin Franklin - first recorded storms Urbain Liverrier - developed international system of telegraphic reports Vincent J. Schaefer - cloud seeding

Bibliography - Weather

Barr, Jene and Cynthia Chapin. *What Will the Weather Be?*. Chicago: Albert Whitman, 1965.

Gibson, Gertrude. *About Our Weather*. Chicago: Melmont Publishers, 1960.

Hitte, Kathryn. *Hurricanes, Tornadoes, and Blizzards*. New York: Random House, 1960.

Irving, Robert. *Hurricanes and Twisters*. New York: Alfred A. Knopf, 1955.

Kinney, Jean and Cle. *What Does the Cloud Do?*. New York: Young Scott Books, 1967.

McGrath, Thomas. *Clouds*. Los Angeles: Melmont Publishers, 1959.

Podendorf, Illa. *The True Book of Weather Experiments*. Chicago: Children's Press, 1961.

Provus, Malcolm. *How Weather Affects Us*. Chicago: Benefic Press, 1963.

Shigley, Forrest D. *Randy Raindrop Takes a Trip*. Minneapolis: T. S. Denison and Company, Inc., 1960.

Mediography - Weather

	Division of Resource Services A-V Number
Air: A First Film	1148
Finding Out About the Clouds	5734
Let's Find Out About the Weather	10675
Our Weather	7271
Play in the Snow	1369
Shadows on the Snow	1445
Snow: A First Film	934
A Time for Rain	1081
A Walk in the Rain	7598
What Makes Rain	1411
Whatever the Weather	2377

No. SP-116 Familiar Cloud Forms - Study Prints (Society for Visual Education)

No. 7761 Five-Day Temperature Chart (John R. Green Company)

No. 24190 Seasons and Weather Songs for the Flannel Board (David C. Cook Publishing Co.)

No. 1443 Thermometer, Dual Scale, F°/C° (Warehouse Catalog)

OBJECTS IN THE SKY

Rationale

Young children usually view objects and events from their own frame of reference. They are aware of the presence of the sun during the day and its absence at night. They tend to think of the sun as an accommodating object that shines for them during the day but does nothing at night. Darkness is viewed by them as a time when they usually do not go outdoors to play and when the stars and moon come out. Some children are aware that during certain times of the year night comes earlier. Many children have wished on a star. Most primary children have a limited understanding of the concepts of size, distance, time, space, and motion as related to the universe.

Background for the Teacher

Interesting discussions should develop as children reveal their conceptions and misconceptions about heavenly bodies. Observing, describing, and recording are emphasized in this unit. Due to its nature, many demonstrations and simulations are necessary. The teacher must consistently help children relate these to the real Earth and the real Sun. It may be helpful if the teacher directs the children's attention to the differences in the equipment and the real objects; for example, the light representing the sun is too small; or the globe representing the earth is too small; or the globe and the light are too close together.

As the children observe, describe, and record natural events, they should begin to realize that there is an orderliness in the universe. The success of children understanding the concepts in this unit depends upon their ability to apply what they learn from working with representational materials to what really happens in nature. This takes many experiences and several years for most children.

While many of the activities in this unit are in the cognitive domain, the affective domain is also emphasized. Children should begin to develop an appreciation of the beauty of a sunrise, sunset, full moon, comet, or a constellation.

The universe is mostly empty space with galaxies. A galaxy is a huge mass of gas, dust, and billions of stars that rotates around a center. Our solar system is a part of the Milky Way Galaxy.

A solar system is composed of planets, their moons, comets, meteors, asteroids, and the sun. The sun is the center of our solar system; the other objects revolve around it. The sun, moon, and Earth are a subsystem of the solar system.

To understand this, Newton's laws must be considered. Newton's first law of motion states that an object at rest will remain at rest until some force starts it moving; an object that is moving will continue to move in the same direction and at the same speed unless some force makes it change directions or speed. If only inertia were acting upon the planets, they would travel straight into space. The gravitational pull of the sun interacts with the planets. Newton's law of gravity states that every object in the universe attracts or pulls on every other object; the greater the weight of an object, the greater its pull on another body. Since the sun is heavier than any of the planets, its gravitational pull on any planet is greater than the planet's pull on the sun. If only gravity interacted with the planets, they would be pulled to the sun. Both inertia and gravity interact with the planets and cause them to travel around the sun. Balanced forces are necessary to keep objects in orbit.

Sun. The sun is a star. It does not look like other stars because it is much closer to Earth than other stars. Although the sun is classified as an average star in size, it radiates vast amounts of energy into space every second. Many people refer to the sun as a ball of "burning gases."

People are dependent upon the sun for heat and light. The teacher should caution the children to look at the sky, never directly at the sun. Its brightness can cause serious injury to the eyes.

The color of sunlight changes during the day. The sun has to pass through more of the atmosphere during morning and late afternoon than at noon. This results in more long wave length red light penetrating the atmosphere than short wave lengths that compose sunlight. Beautiful and breathtaking sunrises and sunsets result. Children need to know that they are most likely to get a sunburn at noon because more sunlight can penetrate the atmosphere at that time.

The diameter of the sun is about 109 times the diameter of Earth. The diameter of Earth is about four times that of the moon. The sun appears to be smaller than the moon because the sun is farther away (approximately 93 million miles). The farther away an object is, the smaller it appears.

Moon. Next to the sun, the moon is probably the most conspicuous object in the sky to people on Earth. The following information refers to Earth's moon, not the moons of other planets.

The moon is the nearest body to Earth and is Earth's only natural satellite. It appears to rise and set due to the rotation of Earth. The moon revolves about Earth in a little less than 28 days. Due to this revolution, the moon rises and sets on an average 51 minutes later each day.

The same side of the moon always faces Earth. The moon rotates as it revolves. Half of the moon is always in sunlight. As the moon revolves around Earth, the amount of its lighted part visible from Earth changes. The diagram on page 235 shows the phases of the moon.

The gravitational force of Earth is much greater than the moon's. The surface gravity on the moon is 1/6 that of Earth. The moon's gravitation is insufcient to hold an atmosphere.

Earth. Earth is not perfectly round. Recent studies from the International Geophysical Year indicate a possible pear shape. As children use a globe, however, Earth should be considered a sphere.

The rotation of Earth on its axis determines day and night. As it spins in space, it has about half of its surface in darkness. The side of Earth which is away from the sun is dark. Since it keeps turning, different parts of it are continually turning into the dark area away from the sun. When people are in the dark area, it is night.

When an object is dropped near Earth, the object tends to fall toward the center of Earth. However, if the object is given a forward push, it will tend to fall in a curved path. Earth's gravity is a force that pulls objects toward the center of it.

Constellations. Constellations are stars that appear to be close together as viewed from Earth. To imaginative early observers, they seemed to resemble familiar objects. The Big and Little Dippers are easy to identify.

Planets. Heavenly bodies that move around a star are planets. Nine known planets move around the sun in our solar system. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

Satellites. Objects that revolve around another heavenly body in a regular path are called satellites. Man-made satellites have been placed in orbit.

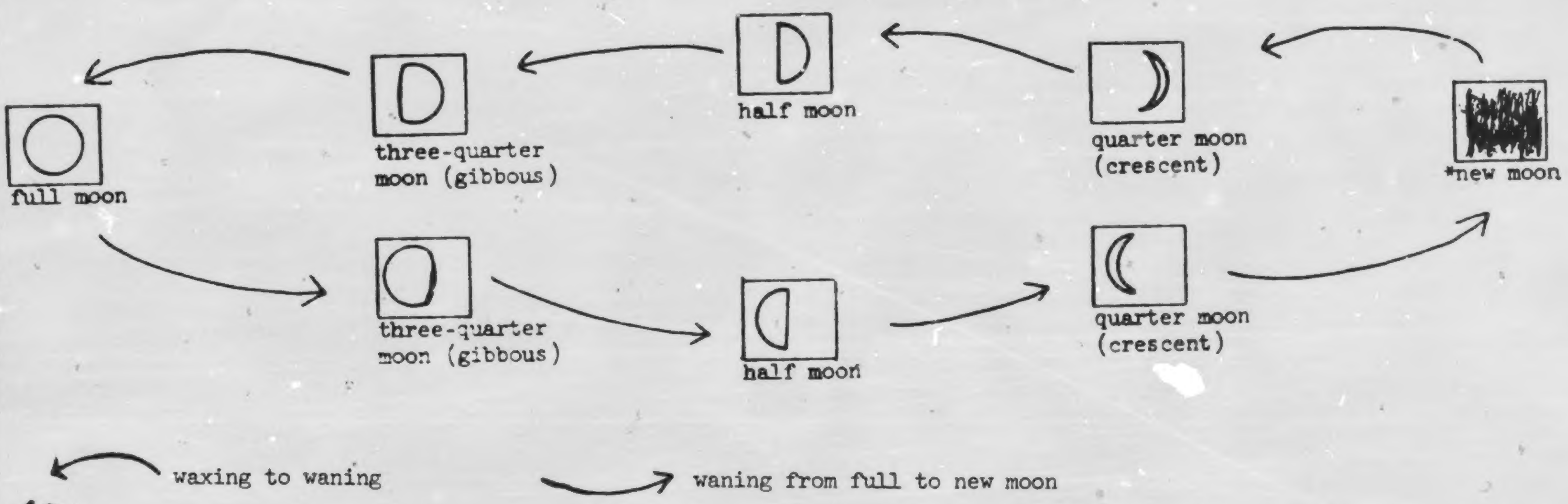
Rockets are used to give satellites enough of a forward push to enable the satellite to fall around the curve of Earth rather than fall toward its center. The satellite must be fired high into space where there is very little friction; otherwise it would become hot and burn.

Rockets are thrust into the air by the formation of hot gases from fuel and oxygen. As the gases are moved in one direction, the rocket is thrust in the other direction. After lift-off, the rocket moves straight up through the atmosphere. It can be directed by small rockets being fired off to the sides. This pushes the rocket to the opposite side. Rockets having more than one stage drop off a stage after its fuel has been used.

Rockets carry instruments to measure temperature, air pressure, and to find out about the composition of the atmosphere. They enable people to communicate more efficiently and over great distances. (Telstar satellite) Radio messages and photographs are sent back to Earth for study. Through the space program, some modern household materials and medical equipment have been developed.

A space station may be used something like an airport on Earth is used. A space station may move around Earth. It will be a stopping place for space ships on their way to the moon and the planets.

Phases of the Moon


half moon
three-quarter moon (gibbous)
quarter moon (crescent)
full moon
*new moon
three-quarter moon (gibbous)
half moon
quarter moon (crescent)
waxing to waning
waning from full to new moon

*At this time the moon is between the sun and Earth. The moon is not visible to Earth.

Concept	Performance Objectives
Object. An object refers to a piece of matter.	The child will be able to name three objects seen in the sky.
Man-Made Object. A piece of matter made by people.	Given a set of objects or pictures, the child will be able to classify according to natural and man-made objects.
Sun. The sun is a star that radiates vast amounts of energy.	
Properties of the Sun. The sun has characteristics or attributes.	

Materials Needed	Learning Activities
a clear day chart paper	On a clear day, take children outside and observe all the objects they can see in the sky. List the objects observed. Guide children to think of other objects that may appear in the sky during day or night; record.

Objects We See
in the Sky

sun	kite
stars	clouds
birds	balloons
fireworks	jets

#Discuss with children the idea of "natural object and man-made object." Refer to the above chart. Ask: What kinds of objects can people make? Contrast these with the moon, a star, a cloud, and the like. Ask: Which are man-made? natural?

Materials Needed	Learning Activities
pictures of natural objects in the sky pictures of man-made objects in the sky	Have children classify according to natural and man-made objects. This may be developed into two charts. Make pictures to match the words--a picture-dictionary type of reference chart. Or make a mobile of each.

Natural Objects in the Sky	Man-Made Objects in the Sky

Note: Many of the following activities need sunny days. It is recommended that the teacher always prepare an alternate lesson.

#Discuss with children their experiences in the sun. Focus on its effects; for example, sunburn, sun allergy, and sun poisoning. Ask: How did you feel when these happened? Explain that they are most likely to get a sunburn at noon. Discuss use of preventives--sunburn lotions and creams. Identify the people involved--druggist, doctor, and dermatologist.

Concept	Performance Objectives
Intensity. The brightness of an object.	The child will be able to explain why it is important never to look directly at the sun.
Temperature. How hot or cold a substance is.	Given materials or pictures, the child will be able to predict the change that will occur when the object is placed in the sun.
Motion. The sun seems to move across the sky during the day. It is not moving. The apparent motion is caused by the rotation of Earth on its axis.	Given appropriate materials, the child will be able to demonstrate how Earth moves around the sun.
	The child will be able to describe how the sun seems to move across the sky.

Materials Needed	Learning Activities
for each child: paper box wax paper	Make a small hole in the bottom of a paper box. Cover the open end of the box with wax paper. Have children hold the bottom of the box toward the sun, but not in front of the eyes. Ask: What makes the bright spot on the paper? (light from the sun) Why is it important not to look directly at the sun?
2 foil pans 2 pencils, 2 nails 2 wood blocks 2 thermometers	Have a child place one of each set in the sun, the other in the shade. After 30-40 minutes, have the child feel the objects and compare the temperature of each set. Ask: What is the difference? Why? Have a child touch a thermometer to the nail in the shade, in the sun. Compare readings.
two glasses, water thermometer, sunlight	Have a child put water in two glasses. Put one glass in the sun, the other out of the sun. Have another child measure with the thermometer and record the temperature. Ask: What did you find out? (The sun provides heat.)
globe signs: "Earth," "Sun" pins	Pin the signs on two children. Ask the child tagged "Earth" to walk around the child labeled "Sun." Have "Earth" keep turning left to right (rotating) as it walks along its path (revolves) around "Sun." Choose other children.
light source globe	Keep the light source (Sun) in one place; turn the globe (Earth) counter-clockwise. Point out to the children that the "sun" did not move.
plant	Have a child place a plant in the sunlight; watch its shadows for a day and mark shadows every hour.
3 rocks (numbered) felt pen	Take children outside in the morning to look for shadows. Label the rocks. Mark the shadow of a tree or pole with one rock placed on the ground at the tip of the shadow. Call attention to the position of the sun. Repeat at noon and afternoon and place a rock each time. Ask: Why did the shadow move? What kind of a shadow does the sun make in the morning? at noon? in the afternoon? Could you tell the exact time of day by looking at shadows? Return the next day at the same time and repeat the experiment.

Concept	Performance Objectives
Motion. (continued) The sun seems to move across the sky during the day. It is not moving. The apparent motion is caused by the rotation of Earth on its axis.	The child will be able to describe how the sun seems to move across the sky.
	Given a chart, the child will be able to keep a record of daylight and darkness for a given activity.
	Given a chart with data from another city, the child will be able to compare with findings for Cincinnati.
Color. The color of sunlight changes.	Given objects or pictures, the child will be able to describe color change of sunlight.
501	502

Materials Needed	Learning Activities
room with sunlight objects in sunlight	Ask: Where does the sunlight come in our room in the morning? Have children identify the objects in the sunlight in the morning. Ask: Where is the sunlight at noon? What objects are in the sunlight? Before school dismissal time, check the location of the sunlight; have them identify the objects in the sun. (The sun appears to be moving.)
black crayon almanacs map of U.S. monthly chart for year	#Make a chart of daylight and darkness for Cincinnati. Information needed can be found in an almanac. Have children record at the top of the first column the time the sun rises in Cincinnati on January 21. Mark this time with a line on the chart. Mark the time the sun sets on that day. Color the night hours black. Leave the daylight hours white. Record the lengths of each of the other days in the same way. Ask: How does the length of day affect some occupations? (farmers, pilots, river pilots)
	Note: Most almanacs give sunrise and sunset times for each day of the year for sample locations, generally for every 5° of latitude between 45° and 30° N. Find the latitude of Cincinnati on a map and then use the figures in the column which approximate this.
daily chart for month black crayon daily newspapers	Variation: Using the above procedure, have children keep a record of sunrise and sunset for a month. Discuss observations from data on chart; for example, length of days and nights; how much daily change in daylight; monthly change; the months that have the shortest/longest days; the months the nights are shortest/longest; the months the days and nights are almost the same.
sunny days	At different times on a sunny day, ask the children to look at the sky, not the sun, and describe the colors and record. Repeat this experience several days. Ask children to look at the sky at sunset and report back what changes were observed. (From morning to afternoon and sunset, the color gets brighter and usually changes from yellow to orange to pink-orange.)

Concept	Performance Objectives
Color. (continued) The color of sunlight changes.	The child will be able to explain how the color of sunlight changes.
Size. The apparent size of the sun is not its true size.	
Energy. The sun radiates vast amounts of energy. People are dependent on the sun for heat and light.	The child will be able to explain the importance of the sun to people.
Interaction. Objects interact when they do something to each other.	
Interaction of Sun and Earth. The interaction of the sun and Earth results in day and night.	Given materials, the child will be able to demonstrate day and night.

Materials Needed	Learning Activities
cardboard dowel sunny day	Insert the dowel vertically in the cardboard. At each hour, have children mark the tip of the shadows and observe the position of the sun. After they have a record of the tips of the shadows, ask them to connect the points. Ask: How does the curved line look? Relate to the path of the sun across the sky. (The apparent motion of the sun is caused by the rotation of Earth.) Repeat, but this time ask the children to observe and record the color of the sunlight next to the tip of each shadow. Discuss and compare the changes in color of sunlight during the day. Have children connect the points and compare this curve with the one made previously.
3' (1 m) string chalk thumb tack dime	Tie a piece of chalk at one end of the string and a thumb tack at the other. Push the thumb tack into the floor; draw a circle with the string stretched tight. Place a dime beside the chalk circle. (The dime represents Earth and the chalk circle, the sun.) Have children compare sizes.
9" ball	To develop some understanding of relative size and distance, take the children outside. Have them observe the basketball at close range. Choose a child to carry the ball to a distant corner. Ask: How does the size appear to look now? (Relate to size and distance of sun.)
reference materials: films/filmstrips study prints/books	Ask: Why is the sun important to people? Why do they need the sun? Have children write imaginary stories about what Earth might be like if there were no sun.
piece of clay small stick light source, globe Note: If globe is metal, use magnet instead of clay.	Find the approximate location of Cincinnati, Ohio. Fasten clay and the stick on the globe to denote Cincinnati. Put the globe and the light source on a table. Have a child turn the globe slowly from left to right. Ask children to watch the clay and the stick as the globe is turned. Ask: When is the clay having "day?" When is the clay having "night?" Watch the stick as the globe is turned. Ask: What can you find out about the shadow of the stick? Repeat several times.

Concept	Performance Objectives
Interaction of Sun and Earth. (continued) The interaction of the sun and Earth results in day and night.	Given materials, the child will be able to demonstrate day and night.
Moon. The celestial body that revolves around Earth. The moon is the only natural satellite of Earth. It has no light of its own. The moon reflects some of the light from the sun.	
Properties of the Moon. The moon has certain characteristics or attributes.	
Shape. The moon reflects sunlight to Earth. The amount of the lighted part of the moon viewed from Earth changes during the month.	Given appropriate materials, the child will be able to demonstrate how the moon reflects sunlight to Earth.

Materials Needed	Learning Activities
globe flashlight	Have a child find Cincinnati on the globe and flash the light on this area to denote "daytime." Keeping the flashlight in the same place, have him gradually turn the globe from left to right half way around. Ask: Where is Cincinnati now? Is the sun always shining? Repeat.
signs for each country flashlight	Variation: Have six or more children stand in a circle. Give each child the name of a country on the globe. Shine the light on one of the children. Have the circle of children move slowly from left to right. Ask: Which country has "day" and which has "night?"
	#Discuss with children their conceptions of the moon. The following questions may serve as guidelines for the discussion. When do you see the moon? Why do you see the moon? Why do you think it looks different at different times? What do you think makes it visible from Earth? When have you seen a full moon; a thin moon? What did the astronauts learn about the moon? How does it look? Where have you seen the moon rise?
mirror flashlight globe sheet of shiny white paper	If direct sunlight is available, ask several children to use a mirror to reflect light from the sun onto various surfaces. Then ask a child to hold a mirror in a darkened part of the room. Ask: Does the mirror have any light of its own? Where did the light come from that the mirror sent to the various surfaces? Place the globe (Earth) on a table in a darkened room. Ask one child to hold the light (the sun); the other, the paper (the moon). The "sun" should shine the light onto the "moon." Tell the child to direct the second child to move the paper so that light reflects onto "Earth."

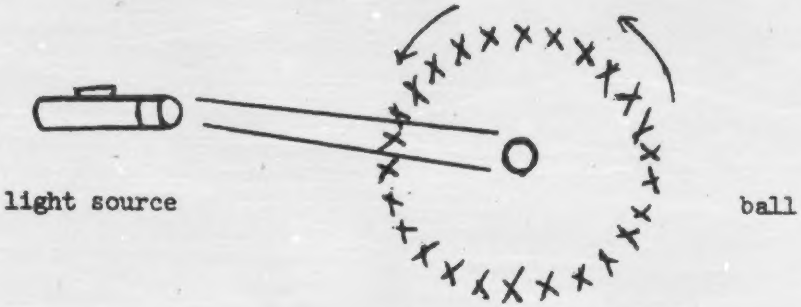
511

512

Concept	Performance Objectives
Shape. (continued) The moon reflects sunlight to Earth. The amount of the lighted part of the moon viewed from Earth changes during the month.	Given appropriate materials, the child will be able to demonstrate how the moon reflects sunlight to Earth.
Phases. The apparent change in the shape of the moon.	Given a data sheet, the child will be able to keep a record of the phases of the moon for four weeks. Given cut-out shapes of the moon, the child will be able to order according to the phases that occur during a month.
Motion. The moon moves around Earth approximately once each month.	The child will be able to demonstrate changes seen in the shape of the moon.

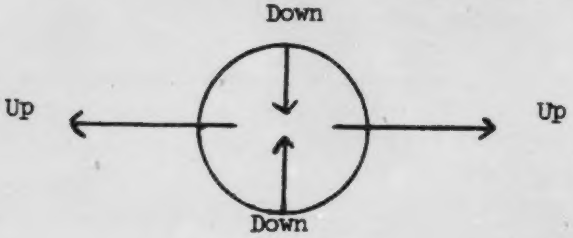
Materials Needed	Learning Activities
	Let other children do the previous activity. Allow sufficient time for each demonstration of light being reflected from the paper onto the globe. The following questions may serve as guidelines for the discussion: Does the paper have a light of its own? the mirror a light of its own? Where did the paper get the light it sent out? Where did the mirror get the light it sent out? Are the mirror and the paper more like the sun or the moon? Develop the word "reflect." Explain that the moon reflects light.
tennis ball flashlight darkened room	In a darkened room, aim the light from the flashlight onto the tennis ball. Ask: Why can we see the tennis ball? (Some of the light from the flashlight is reflected from the tennis ball. Relate to the moon which has no light of its own but reflects the sunlight.) Have a child bounce a ball on the wall; observe the ball bouncing back. (Relate to light.)
data sheet for each child	Ask children to look at the moon twice a week; observe its shape and record on the sheet by drawing the shape and indicating the date and time observed. At the end of four weeks, discuss the findings. Children may save these records and continue their observations and individual recordings for a second month. Or keep a group record for the second month. Compare findings for the two months. Ask: What pattern did you observe?
data sheet for each child	Have children look at the sky at day and night to see whether the moon is visible and record observations. They may wish to ask their parents to make a second or third observation later the same night. Compare findings.
string white ball	Suspend a white ball on a string. Ask a child to hold the string out at arm's length. In a darkened room with one fixed light source, have the pupil make quarter turns to the left, thus enabling the class to see "phases of the moon" on the ball.

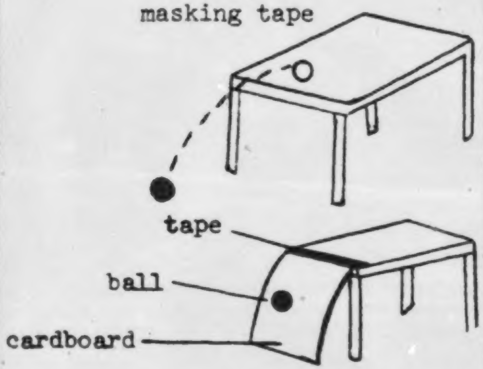
Concept	Performance Objectives
Motion. (continued) The moon moves around Earth approximately once each month.	The child will be able to demonstrate changes seen in the shape of the moon.
Size. The apparent size of the moon is not its true size.	

Materials Needed	Learning Activities
circle of paper scissors large volleyball or kickball flashlight	Have one child hold up a ball on the palm of his hand. Arrange children in a circle. Put the ball in the center; shine the light source directly on the side of the ball. Darken the room. Have children move around the circle counterclockwise to observe "phases of the moon" on the ball. When children return to their original place on the circle, have them cut individual paper circles according to the "phase" they observe from their place. (The "paper phases" can be combined for a bulletin board display.) 
2 pieces of paper-- 1 large, 1 small	Cut a large round piece of paper 2' (61 cm) in diameter. Tape it to the wall. Cut a smaller circle 5" (13 cm) across. Go to the opposite side of the room; face the larger circle and hold the smaller circle in front of you. Ask: Which circle looks larger? (The farther away an object, the smaller it appears.)
rubber balls of different sizes	Place two different-sized balls at opposite ends of the gymnasium. Ask: Are the balls the same size? How can you know for sure? How can you make the small ball look the same size as the larger ball? Ask the child to close one eye, lift the small ball from the table and move it slowly toward his open eye. Keep looking at the larger ball. Discuss with children that the apparent size of an object varies with the distance the object is from the observer. The apparent size of the moon and stars is not their true size.

Concept	Performance Objectives
Size. (continued) The apparent size of the moon is not its true size.	
Gravity. Moon's gravity is a force 1/6 that of Earth's. It is not sufficient to hold an atmosphere.	
Earth. The planet on which we live.	
Properties of Earth. Earth has characteristics or attributes.	
Motion. Earth rotates from west to east.	Given materials, the child will be able to demonstrate how Earth moves around the sun.
Gravity. Earth's gravity is a force that pulls objects toward the center of Earth.	Given objects, the child will be able to predict where they will go.
Down. Down usually refers to the direction an object falls when it is dropped. Near Earth down is the center of the Earth.	Given appropriate materials, the child will be able to demonstrate "down."

Materials Needed	Learning Activities
reference materials	Some children may wish to research old sayings, such as "man in the moon," "the moon is made of green cheese," and folk myths about the moon.
length of string	Explain that people weigh 1/6 as much on the moon as they do on Earth; therefore, people can jump six times farther. Measure children's jumps by marking off length with string. Then mark off 6 times that length. Compare the "two jumps."
signs: "Earth," "Sun" pins felt marker	Pin the signs on two children. Have the child with the sign, "Sun," hold the light source and stand in the center of the room. The child with the sign, "Earth," moves from left to right around the "Sun" to illustrate how Earth moves around the sun. (Child should spin slowly to simulate Earth turning on its axis as it revolves around the sun.)
objects of different sizes	Have children jump up. Ask: What happens? Repeat. Describe what happens. Have each child hold an object in hand and let it go. Ask: Where does it go? Experiment with different size objects. Ask: Where does the object always go?
ball	Have several children release a ball without giving it any forward push. Ask: Where does the ball fall? (The direction in which the ball falls is considered down.)

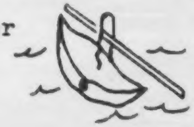
Concept	Performance Objectives
Up. Up is the direction opposite down. 	
Gravity. (continued) Earth's gravity is a force that pulls objects toward the center of Earth.	Given appropriate materials, the child will be able to demonstrate how an object can be made to fall around Earth.

Materials Needed	Learning Activities
clay 2 plastic or paper figures of people globe	Place a figure on the globe at Cincinnati, Ohio. Ask: In what direction would the ball fall? ("Down"--toward the center of Earth.) Place another figure on the globe in Australia. Ask: In what direction would the ball fall? ("Down"--toward the center of Earth. It may seem strange to many children that the direction "down" would be almost opposite in Australia to the direction "down" in the United States. An object will fall toward the center of Earth on the other side of Earth as well.) Move figures to different locations and repeat the above procedure.
for each group: rubber balls, globe cardboard (to reach from edge of table to floor) masking tape 	Divide the class into groups. Let a ball drop from the edge of a table. Mark where it hits the floor. Ask: How did the ball fall? (It falls straight down when dropped from the edge of a table.) Repeat. This time place the ball on the table. Push it forward gently. Mark where it hits the floor. Ask: How did it fall? (It falls in a slightly curved path when gently pushed off the table.) Repeat. Fasten a piece of cardboard from the table edge to the floor. Gently push the ball off the table. Have a child mark on the cardboard where the ball hits the cardboard. Repeat. Push the ball a little harder each time; mark each hit. Have children observe what happens to the ball as it is pushed harder. (It travels a greater distance in a curved path. As the ball is pushed harder each time, it should go beyond the cardboard.)
globe	After developing the above, relate the ball to Earth's gravity. Use the globe to show children that Earth has a curved surface. (As they push the ball harder, it opposes the force of gravity for a time. Relate this to objects that fall around Earth.)

Concept	Performance Objectives
Gravity. (continued) Earth's gravity is a force that pulls objects toward the center of Earth.	
Satellite. An object that revolves around another heavenly body in a regular path.	Given a set of pictures, the child will be able to select those that represent satellites.
Earth Satellite. An object that is moving around the Earth.	
Natural Satellite. Earth is a satellite of the sun. The moon is a satellite of Earth.	
Man-Made Satellite. Man has made satellites to revolve around Earth and heavenly bodies.	The child will be able to state three purposes for sending up satellites.
Rocket. A machine that moves fast enough and has the power to overcome Earth's gravity; is self-supporting. Some carry astronauts; others carry satellites.	Given models or pictures, the child will be able to identify rockets and satellites.
Space Station. A stopping place for spaceships moving from Earth to the moon and planets.	

Materials Needed	Learning Activities
pail with handle ball	Note: This is a teacher demonstration. Place the rubber ball at the bottom of the pail. Whirl the pail in front of you in a vertical circle. Have children observe the ball. Ask: Does it fall out of the pail? What would happen if the pail were stopped when it is above your head?
	Ask: What are the natural objects that can be seen without a telescope? with a telescope? What are the man-made objects people can see without a telescope? with a telescope?
	Have children write imaginary stories regarding: "How Would You Feel if You Were in an Earth Satellite?"
books study prints films filmstrips slides	Discuss with children their knowledge of satellites. The following questions may serve as guides: What are some natural satellites? (Earth's moon, planets) #What are some man-made satellites? #How do people use these satellites to help them live better? Safer? How are satellites different from stars? Why are rockets used to push satellites high into the air? What knowledge do people hope to gain from sending satellites into orbit? #How are satellites used in television?
pictures	Have children collect pictures of some of Earth's artificial satellites, such as the weather satellites in the Telstar series. Prepare a bulletin board display with children's own captions that indicate the uses of such satellites and the types of rockets.

Concept	Performance Objectives
Rocket Propulsion. Thrust. An engine that carries its own oxygen and fuel.	
Orbit. The path of an object in its revolution around another object.	
Astronaut. A person who explores space.	The child will be able to describe an astronaut's life support system.

Materials Needed	Learning Activities
balloon	Inflate a balloon; release. Explain that the balloon is a simple rocket. (A rocket carrying a satellite would release the satellite high in space where there is little atmosphere and friction so it would not become hot and burn up.)
balloon straw string, approximately 15' (4.5 m) long	Make a balloon-powered rocket. Use cellophane tape to attach a drinking straw to one side of a long, blown-up balloon. Measure a 15' (4.5 m) length of string; pass it through the straw. Attach one end of the string to the door handle; pull the string taut. Attach the other end of the string to an object on the other side of the room. Be sure that the balloon is at one end of the string with the opening pointing toward the door handle. Release air from the balloon. (See illustration, page 171.)
styrofoam/hair pin thumbtack kite stick pail of water 	Cut a piece of styrofoam into the shape of a canoe. Insert a hairpin into one side and a thumbtack into the other to balance it. Place it in a pail of water. Insert a kite stick through the loop of the hairpin and paddle in one direction only. Relate to a rocket; it can be turned similar to a canoe.
ball on a rubber string or rubber band taped onto a ping pong ball	Note: This is a teacher demonstration. Swing the ball slowly around your head. Ask: How large is the orbit of the ball? Swing the ball faster. Ask: What happens to the orbit? Relate to satellites. (The faster the satellite travels, the larger its orbit will be.) If you swing the ball fast enough, the rubber band will break and the ball will "escape." Relate this to a space capsule. (If it is made to go fast enough, it will break the bonds of gravity that hold it to Earth and will escape.)
	Guide discussion with questions, such as: What special qualifications must an astronaut have? What special clothes does an astronaut wear? Why? What is different about his personal hygiene?

Concept	Performance Objectives
Star. A huge ball of hot gas in space that produces its own light.	The child will be able to explain why people do not see stars (other than the sun) during the day.
Properties of Stars. Characteristics or attributes of stars.	
Magnitude. The apparent brightness of a star. The magnitude of a star depends upon its temperature, size, and distance from Earth.	
Constellation. Stars that appear to be close together as viewed from Earth.	Given pictures of constellations, the child will be able to identify the Big and Little Dippers.
Comet. A body made of dust and frozen gases that revolves around the sun in an elongated elliptical orbit.	

Materials Needed	Learning Activities
flashlight darkened room sunny day	Darken the room. Shine a flashlight; have children observe its brightness. Take children outdoors on a sunny day; have them observe the brightness of the flashlight. Compare the brightness of the flashlight indoors and outdoors. Ask: Why do we see the stars at night and not in the daytime?
chalk black paper white paper	Write with white chalk on white paper. Write a word on black paper. Ask: Which is easier to see? (Stars are in the sky all the time. In the day it is so bright that other stars cannot be seen.)
piece of white paper light source	Cut a star out of white paper. Hold the light source between you and the star. Ask: Can you see the star? Move the light off to the side. Ask: Is the star more visible? Have children observe the night sky. Ask: What differences did you see in the brightness of stars?
pencil round boxes (oatmeal or grits) flashlight	Draw constellation patterns on the inside lid of an oatmeal box (one pattern to a box). With a sharp pencil, punch holes where the stars are marked. Cut a hole in the opposite end of the box; insert a flashlight. Darken the room; flash the patterns on the walls or ceiling. For a viewing device, make holes much smaller and look into the box while pointing it toward a medium-strength light source.
gummed stars black umbrella	Paste gummed stars on the inside of a black umbrella to represent constellations that children choose. Paste the North Star in the center. Let children take turns pointing the umbrella northward and turning it slowly to see how the constellations rotate around the North Star.
3 pieces of black paper white chalk pencil	Have children show stars in a constellation with or without connecting them. Then punch a hole where each star is located. Fasten to windows or hold to light.
reference materials	Have children use reference materials to find information on Edmund Halley, Halley's Comet, and the comet, Kouhoutek.

Concept	Performance Objectives
Astronomy. The science which deals with the study of stars, planets, and other heavenly bodies and their properties and interactions.	
Astronomer. The scientist who studies astronomy.	The child will be able to explain the work of an astronomer.
Telescope. An instrument which uses mirrors and/or lenses to gather light to bring images of distant objects closer to the viewer.	The child will be able to tell the purpose of a telescope.
Planet. A large heavenly body that moves around a star. Nine planets move around the sun.	Given a picture of the sun and planets, the child will be able to identify the planets by labeling each.

Materials Needed	Learning Activities
reference books filmstrips tapes, tape recorder	#Provide appropriate reference materials and have children read about or make tapes giving information on: Claudius Ptolemy Nicolaus Copernicus Tycho Brahe Galileo Johannes Kepler Benjamin Banneker
	#Interview a "volunteer" sky watcher (astronomer; Civil Air Patrol).
2 magnifying glasses or lenses from old eyeglasses	#Construct a simple telescope using two magnifying glasses. (This makes distant objects seem larger.) Have a child hold one magnifying glass as far away as possible and look at an object. (The object will probably be blurred.) Then have him hold the second magnifying glass close to his eye; look again. Move one glass back and forth and then the other one until the object can be seen clearly. Have him describe how it looks. (A lens from a pair of old eyeglasses and a weak magnifying lens can also be used. The magnifying lens should be closer to the eye.)
	#Take a field trip to the Museum of Natural History (Planetarium chamber).
books study prints films filmstrips	Provide a variety of reference materials and have children develop questions regarding information they would like to research. Suggestions follow. What are the names of the nine planets? Which is largest; smallest? Which is the farthest from the sun; closest? How long does it take for each of the planets to orbit around the sun? Which ones can be observed from Earth without a telescope? Which times of year are better to see certain planets?
chart paper	Make a chart, "Facts About the Planets." Include pertinent information, such as appearance, length of a day, length of a year, temperature, atmosphere, length of time to orbit the sun.

Concept	Performance Objectives
System. A whole made of related parts called objects. The relation may stem from the interaction between the parts or from a common function served by all the parts. Solar System. The sun and all the celestial bodies that revolve around it.	The child will be able to identify objects in his solar system.

Materials Needed	Learning Activities
	To extend the children's understanding of the meaning of system, guide them to think of other systems--school system, water system, nervous system, or digestive system. Relate this to the following systems: children in a classroom; the family; an automobile. Relate system to the solar system. Ask children to identify objects in our solar system. Note: The intermediate science program develops this concept in depth.

Bibliography - Objects in the Sky

Branley, Franklyn M. A Book of the Milky Way Galaxy for You. New York: Thomas Y. Crowell Company, 1965.

Branley, Franklyn M. A Book of Stars for You. New York: Thomas Y. Crowell Company, 1967.

Branley, Franklyn M. Rockets and Satellites. New York: Thomas Y. Crowell Company, revised 1970.

Crosby, Alexander L. Junior Science Book of Stars. Champaign, Illinois: Garrard Publishing Company, 1960.

Freeman, Mae and Ira. The Sun, The Moon, and the Stars. New York: Random House, 1959.

Fuchs, Erich. Journey to the Moon. New York: Delacorte Press, 1970.

Gamow, George. A Star Called the Sun. New York: Viking Press, 1963.

Kinney, Jean and Cle. What Does the Sun Do?. New York: William R. Scott, Inc., 1967.

Podendorf, Illa. The True Book of Seasons. Chicago: Children's Press, 1955.

Polgreen, John and Cathleen. Sunlight and Shadows. Garden City, New York: Doubleday and Company, 1967.

Schneider, Herman and Nina. How Big Is Big?. New York: William R. Scott, Inc., 1946.

Shapp, Martha and Charles. Let's Find Out What's in the Sky. New York: Franklin Watts, 1961.

Skilling, William T. and Robert S. Richardson. Sun, Moon, and Stars. New York: McGraw-Hill Book Company, 1964.

Tellander, Marian. Space. Chicago: Follett Educational Corporation, 1960.

Mediography - Objects in the Sky

	Division of Resource Services A-V Number
Finding Out About the Sky (Basic Primary Science - Group I)	5729
How a Day Passes	6185
Introduction to Our Earth and Sun	7736-7738
Man's Earth Home	5665
Night and Day	7269
The Night Sky	7274
The Sky Above Our Earth (Science for Beginners Series)	6463
The Stars at Night	986
Sunlight: A First Film	1149

Stepping Into Science Book Bags (Children's Press)
- The Moon Ride Rock Hunt (cassette and books)
- The Moonwalk Adventure (cassette and books)

SVE Study Prints (Society for Visual Education)
- No. SP-158 Building Toward the Moon
- No. SP-156 Countdown to Splashdown
- No. SP-139 In the Fall
- No. SP-137 In the Spring
- No. SP-138 In the Summer

LIFE SCIENCE

553

554

LIFE SCIENCE

The Life Science section has two major parts--Plant Organisms and Animal Organisms. The concepts in each are quite similar; however, the topics are organized and developed separately. The teacher is free to develop these with children as separate topics, or simultaneously, if desired. Within each part there is frequently an overlap in activities. The activities often develop more than one concept.

The major concepts in the Life Science section are: organism, characteristics of organisms, diversity, life needs, habitat, life cycle, food web, population, and conservation.

Organisms are individual living things. They can be distinguished from non-living things in that they breathe, move, require some kind of food, grow, reproduce, and respond to stimuli. Non-living things are distinguished from one another by their properties. The properties of organisms are referred to as characteristics.

There is great diversity in the physical characteristics and the behavior of organisms. They differ from each other in many ways, such as size, color, structure, coverings, environment, food, life span, mode of travel, extent of travel, and habitat. There is great variety in organisms existing today, as well as differences in today's organisms and those of long ago.

Living organisms need food, water, air, and protection. Food provides the energy and the materials needed for the growth and repair of the organisms. They use oxygen to burn food and give off carbon dioxide. Plants and animals need protection from enemies, excessive heat, drought, and other unfavorable environmental conditions.

Plants and animals live in a specific kind of place called a habitat. It may be a pond habitat, meadow habitat, or a forest habitat.

Life is continued from one generation to the next by the process of reproduction. The life span of an individual organism varies from a few hours to over a hundred years. The life cycle of individual organisms follows a predictable pattern. Offspring are smaller than their parents. The offspring of some organisms resemble their parents in structure, but differ greatly in proportion and size of major body parts. Organisms such as insects and amphibians have offspring that are greatly different in structure, habits, and diet from the parent. Some organisms change their form one or more times. This is called metamorphosis. The metamorphosis of amphibians consists of three stages--egg, larva, and adult. Insects have four stages--egg, larva, pupa, and adult.

Organisms affect and are affected by their environment. They also affect and are affected by other organisms. The relationships between organisms and their environments and the relationships among organisms are interdependent. Each organism gives something and receives something. Some organisms get food from plants; some feed on other animals. This food relationship is called a food chain. A cricket eats grass; a frog eats crickets; and an owl eats the frog. A food web is a diagram that depicts more complex feeding relationships, such as insects that eat more than one plant; animals that eat more than one animal.

A population is a group of like organisms living and reproducing in a particular area. The population is determined by the number of individuals in the group, not by the physical size of the individuals.

Life science study is an on-going activity. "Waiting-time" is involved as seeds sprout, cuttings root, and animals develop and reproduce. The teacher may wish to have life science study underway, but at the same time, develop a topic from the Physical or Earth Science sections. When changes occur in the plants or animals, the life science study can be resumed.

Plants and animals are essential to each classroom. Housing rules, attitudes, or conditions at home often prohibit children from having their own pets. Therefore, it is highly desirable that children care for animals, not only as part of life science units, but also as an on-going activity throughout the school year.

Living conditions in the classroom should be as nearly like the animals' habitats as possible. Cages, aquaria, and terraria should be durable and of appropriate size and design for the organism. Most animals should remain for a short time only. Animals, such as gerbils, white mice, guinea pigs, and fish, may be kept for longer periods of time. Small organisms, such as mealworms, fruit flies, and earthworms, are easy to care for and provide interesting experiences for children.

Children learn to assume responsibility and begin to develop a feeling of affection toward animals as they feed them and clean their habitats. They should have an opportunity to hold the animals, but avoid excessive handling. Children should also be taught to wash their hands after they handle the pet so that no diseases are transmitted. No experiments should be conducted with vertebrate animals that would deprive them of excellent care or cause them to die.

Children must be taught to respect wildlife and encouraged to leave animals and plants in their natural habitats. When children bring warm-blooded animals, such as rabbits, squirrels, or birds, they should release them in an environment in which they can survive.

People have played a unique role in the environment. They have been able to overcome natural enemies, extract natural resources, use many materials of the earth for their benefit, cultivate crops for food and clothing, and increase the production and quality of plants and animals. In many ways, they have dominated life on Earth.

Unfortunately, people have not always acted wisely in their use of the environment. Their efforts to produce goods to supply their needs and wants have often interfered with the natural cycles. Today they are confronted with problems of pollution, over population, starvation, energy shortages, and endangered species. Children must be taught to act responsibly toward the environment.

Individuals, special interest groups, and scientists have made efforts to protect and improve the environment through community action and legislation. Conserving natural resources, recycling materials, controlling population, and controlling pollution have received attention.

Small animals become treasured classmates, giving children first-hand experience in observing animal behavior and developing pet-care responsibility

PLANT ORGANISMS

Rationale

Children are naturally interested in living organisms. Many have planted seeds, watered plants or overwatered, only to find their plants died. Some children have harvested fruits or vegetables from their families' gardens. Most children appreciate the beauty of plants.

Background for the Teacher

There are many different kinds of plants in the world. There are similarities and differences among them.

It is important that children study plant reproduction from seeds, as well as vegetative reproduction (growth from parts other than seeds). This topic develops plant reproduction from seeds, bulbs, and cuttings.

Seeds of one kind may have characteristics similar to other seeds. Seeds have a seed coat, cotyledon, root, stem, and leaves. The cotyledon contains the food supply for the embryo.

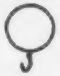
Seeds germinate at different rates according to the variety. Certain combinations of heat, moisture, light, and nutrients help the germination. It is helpful if the teacher selects seeds of rather short germination time, such as marigold, radish, bean, lettuce, corn, and pea seeds. They germinate in approximately five days if the temperature is 65°-75° F. Since some seeds may fail to sprout, it is helpful to plant some "extras."

New plants can be made by taking a cutting from established plants. This is called vegetative reproduction. Remove any flowers or buds and place the cutting in a jar of water or a sterile soil medium. Roots should begin to grow if the plant has been given moisture. Coleus, geraniums, impatiens, or ivy are good to use for cuttings.

It is not necessary to use regular flower pots for growing plants. Containers such as styrofoam cups, paper cups, or milk cartons, can be used. Holes should be made in the bottom to insure proper drainage.

Whether it's inches or centimeters, each day brings new life processes to observe and measurements to record

Concept	Performance Objectives
Organism. An individual living thing.	The child will be able to identify characteristics that distinguish organisms from non-living objects.
Plant. One of two main classifications of organisms.	Given a variety of seeds, the child will be able to describe their properties.
Characteristics of Plants. Plants have certain properties or attributes.	
	Given a variety of seeds, the child will be able to classify according to properties.
	Given a number of plants, the child will be able to serial order according to a chosen property.

Materials Needed	Learning Activities
children's collections	Use collections made by the children. Have them observe and classify the objects in the collections according to living and non-living things. Ask them to explain their classification.
"I Found Circles" (coat hanger bent into this shape) 	Take the children outdoors to find a place with plants. Have each child place the "I Found Circles" on the ground. Ask: What objects do you see inside your circle? Which are living? Which are not living? How many different kinds of organisms can you find inside your circle?
sources for pictures chart paper	Have children look in magazines for pictures of living and non-living objects. Paste on chart, "Living" and "Not Living."
seeds	Before planting seeds, try to assess how much information the children have regarding seeds. Suggested questions: What is a seed? How can you tell which objects are seeds? Where can you find seeds? (in pumpkins, apples, peaches, oranges, grapefruit, avocados, lemons) Cut open some of the foods mentioned. Have children observe the seeds and make a seed display; describe and label each.
handlens variety of seeds soil containers for planting	#Ask children to bring in a variety of seeds. Let them use the handlens to describe the properties of each. Plant the seeds; label each kind. Ask: What do plants need to grow? Why do some not grow? What occupations are dependent on planting and growing seeds?
handlens variety of seeds	Have children use the handlens; describe the seeds. Classify according to a chosen property--size, color, or shape.
collection of seeds	Have children order the seeds according to a chosen property.

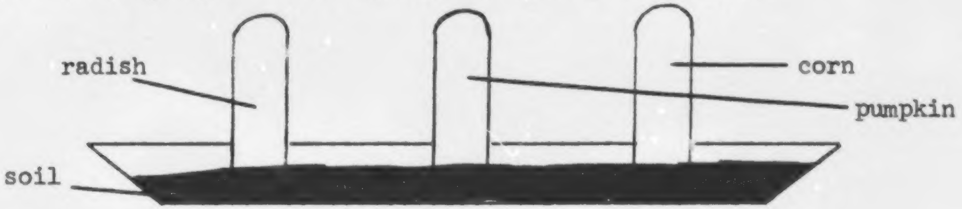
Concept	Performance Objectives
Characteristics of Plants. (continued) Plants have certain properties or attributes.	Given a seed, the child will be able to locate the food source.
	Given a plant, the child will be able to identify its parts and functions.
Diversity. The way in which organisms are alike or different from one another (characteristics).	Given a variety of plants, the child will be able to describe their likenesses and differences.
Needs. All organisms have certain requirements in order to sustain life.	Given a variety of seeds, the child will be able to tell the requirements for seed germination.
	Given a variety of seeds, the child will be able to classify according to rate of germination.
Birth. The act of bringing forth new plants. Plants grow from seeds, other plants, and parts of plants.	Given a variety of plants, the child will be able to state the requirements for growing new plants.

Materials Needed	Learning Activities
bean or corn seeds water container for water	Soak some bean or corn seeds in water overnight. Give each child a seed to open. Ask: Where is the plant's food source? Have each child plant another seed. Chart the growth of the plants.
seeds cotton glass jar	Have children plant seeds on moistened cotton along the side of a glass jar. Observe the growth. Have them identify the various parts of the plant--seed coat, roots, stem, bud, leaf, flower, or fruit. Discuss function of each part.
variety of seeds, such as marigolds, sunflowers, pumpkin, zinnia, radish, or pea soil, containers	Have children describe the seeds. Plant the seeds. As the plants grow, ask: How are the plants alike? Different?
	#Visit a farm, greenhouse, or nursery. Have children observe the different kinds of plants. Compare likenesses and differences.
seeds, soil containers for planting paper for graphs	#Plant seeds. Use control and experimental pots to observe and record what happens to seeds without water, sun, and good soil. Ask children to keep graphs to record growth of the seedlings. Discuss the work performed in greenhouses and nurseries.
variety of seeds plastic container paper towels	#Allow a variety of seeds to germinate in a shallow plastic container on a dampened towel. Have children observe and record the date seeds were planted and the rate of germination of various kinds.
avocado seeds toothpicks container water	Stick toothpicks around the center of the seed. Set the seed, anchored by picks, into a filled container of water. Be sure the pointed end is above the water level. Note: Roots should appear in 6-12 weeks, followed by a stem and leaves. When the sprout has three or four leaves, transplant into a large clay pot containing potting soil; keep soil moist.

Concept	Performance Objectives
Birth. (continued) The act of bringing forth new plants. Plants grow from seeds, other plants, and parts of plants.	Given a variety of cuttings, the child will be able to describe the growth of a plant from a cutting.
	Given a variety of plants, the child will be able to describe the growth of a plant from another plant.
	Given a variety of bulbs, the child will be able to describe the growth of a plant from a bulb.
Death. The ending of life.	
	Given a terrarium, the child will be able to describe the changes that occur (birth, death, growth).
Growth. The process of increasing in size.	Given a seed, the child will be able to describe the changes during the germination of a seed.

Materials Needed	Learning Activities
joint plants, such as coleus, geranium, or English ivy potting soil containers water	Place a cutting from one or more of the joint plants in a container of potting soil or water. When roots have grown enough to support the plant, transplant into pots filled with soil. Keep plant away from bright sun until roots have developed.
sweet potato toothpicks container water	Stick three or four toothpicks around the center of the potato and set it into a container of water that will cover half of the potato. Roots and sprouts should soon appear on the potato.
bulbs, such as onion, crocus, or narcissus container potting soil	Plant bulbs in a container of potting soil. Keep the soil damp. Roots and sprouts should soon appear.
plants	When a plant in the room dies, discuss with children what may have caused its death. (Possible reasons: too much water, not enough light, too much light, in a draft, or too near a heat source.) Ask: What did we see happening that told us it might die?
terrarium plants soil	#Construct a terrarium. Ask children to describe the characteristics of the rooted plants. If possible, take the class to a wooded area to collect organisms for the terrarium. Have children keep a record of their growth; observe any organisms that die. Ask: What signs told us it might die? Why did it die? When did it die?
10 corn seeds container for planting soil	Plant ten corn seeds. Have children water regularly and observe growth. Remove one seed daily to observe its appearance. Replant until plants are above the soil level. Continue observing the growth process. Draw pictures of the seed removed each day. Note: Caution children that not all seeds may be pulled up.

Concept	Performance Objectives
Development. An organism passes from one stage of maturation to the next. This is recognizable by the appearance of new structures.	Given a plant, the child will be able to measure and record the stem growth over a period of time.
	Given a group of plants, the child will be able to explain the changes in growth.
Habitat. The place in the environment where a particular organism normally lives.	The child will be able to explain that a garden is the place where plants are grown.

Materials Needed	Learning Activities
seeds soil containers	Sort and identify the seeds. Fill the container with moist soil and mark one lane with a popsicle stick for each group of children. Have each group tape a sample of its kind of seed to the stick. Each child in a group should plant a seed in the group's lane. Record the growth of the stem. 
bean seeds, handlens label germinating dish, cover blotter, water	Have each child write his initials on the label and place it on the dish. Put the blotter in the dish; add water. Place the beans on the blotter and cover the dish. Look at the seeds each day and record changes in growth.
flower seeds soil containers	#Display a collection of different seed packets. Label the display with questions, such as "How do plants grow and change?" "What do we call a person who plants seeds and grows flowers?"
handlens	Take the children on a short trip around the school building. Observe where plants are growing. Be sure to check cracks in the sidewalk or walls. Have children draw pictures showing where they observed plants growing. Ask: What do you know about gardens? What are different kinds of gardens? (window box, indoor gardens, terrarium, greenhouse, rock garden, community garden, and truck farm)
	#Visit a florist. Ask: Where does the florist get the flowers? How are the flowers kept fresh? What does the florist do with the flowers? Why do people buy flowers?

Concept	Performance Objectives
Habitat. (continued) The place in the environment where a particular organism normally lives.	The child will be able to explain that a garden is the place where plants are grown.
	The child will be able to describe the characteristics of a few kinds of molds.
	Given a group of materials, the child will be able to select those that can support the growth of molds.

Materials Needed	Learning Activities
	#Visit a neighborhood garden, greenhouse, or Krohn Conservatory. Have children observe the various kinds of plants. Discuss why plants are grown in a greenhouse. Interview a greenhouse employee or volunteer.
garden tools seeds soil	If the outdoor space on the school grounds is sufficient, the teacher may wish to help children plant an outdoor garden. Note: Use crops that germinate and produce in a short amount of time--lettuce, radishes, or onions.
	#Interview people in the community who garden. Ask: Why do they garden? Discussion should include the enjoyment of raising plants and arranging flowers and the economic reasons of cutting costs by raising food.
	#Interview a landscape architect. Ask: How does this person help in conservation?
	#Visit Spring Grove Arboretum or Krohn Conservatory. Observe the workers. Contact members of the Garden Club to serve as resource persons.
clear plastic wrap several large clear containers (jars, aquaria, tumblers, transparent refrigerator dishes) soil (Topsoil will speed the mold growth.) pieces of bread, ripe fruit, vegetables, cheese, or coffee grounds crayons, chalk, rocks, pencil or thumbtacks handlens	Put the soil in the containers; add pieces of remaining materials. Sprinkle with water. Cover. Put in a warm, dark place. Ask: What are the characteristics of the molds? Record the change in growth; date. Ask: What do people do with food that has mold on it? Note: Explain that mold is a tiny plant that grows on certain materials. Make mold gardens by using a variety of materials. Place in different locations, such as light area, dark area; warm place, cool place. Compare the findings.

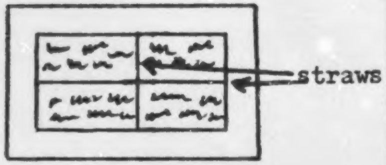
Concept	Performance Objectives
Live Cycle. The sequence of changes an organism passes through as it develops from a seed to an adult plant and, in turn, produces seeds which give rise to the next generation.	The child will be able to describe the life cycle of a plant.
	Given a set of pictures of a plant, the child will be able to arrange in sequential order the stages of its life cycle.
Genetic Identity. Living things reproduce their own kind.	Given a set of pictures, the child will be able to match the plant with its source.
Population. A group of organisms of the same kind living and reproducing in a particular area. Population is determined by the number of individuals in the group and not by the physical size of the individuals.	The child will be able to identify populations of organisms in a natural setting.

Materials Needed	Learning Activities
bean seeds soil rulers containers paper crayons	Have children plant seeds. As the seeds grow, ask the children to identify at least four events. 1. Seed in soil 2. Seed coat cracking 3. Seed emerging from soil 4. First leaves For each event, have children record data (pictograph with dates). Compare differences in the growth. Draw pictures of plant as it continues to grow.
study prints	Show pictures of the life cycle of a plant and discuss the stages of growth with the children.
crayons paper	Have children draw pictures that represent the various stages of the life cycle of a plant, such as the sunflower. Cut apart. Have children arrange them in sequential order.
sunflower seeds flower pots soil, water	#Have children plant seeds early in the fall; water. Place pots under light or in a sunny window. Plants should grow and eventually produce flowers. When flowers die, remove seeds and replant. Repeat the process throughout the school year.
seeds plants growing in flower pots	Label flower pots with plants already growing so the children can observe them. Give the children a tray of mixed seeds to identify. Label these. Have the children plant them and observe whether they grow into a plant that corresponds to the labeled one.
chart paper marking pen	#Ask: What plants live in the same community with you? List these on the chalkboard or on a chart similar to the following:

Plants in Our Community

trees	flowers	grass
bushes	weeds	vines
shrubs	vegetables	

Concept	Performance Objectives
Population. (continued) A group of organisms of the same kind living and reproducing in a particular area. Population is determined by the number of individuals in the group and not by the physical size of the individuals.	The child will be able to identify populations of organisms in a natural setting.
	The child will be able to identify the environmental conditions that cause an increase in growth or decrease of a population.

Materials Needed	Learning Activities
chart from preceding page	#Ask: Which plants do people take care of? (Draw a line under each.) What would happen to these if the people in the community disappeared? (Children should infer that without people some plants would probably die.)
grass seed, soil container, straws  	Have children plant grass seed. As the grass grows, ask: How many plants are in the container? Compare the counts of various children. Largest count? Smallest count? Record. Direct the children to use their straws to divide the plant population into four equal parts. Ask: How many plants are in one of the four parts? Multiply this number by four. Compare with the original count. (This is an estimate of the size of a population. A sample of the population was used.)
	Take a field trip to an area in or near the school grounds. Have children search for evidence of a natural community. Have them look for plants and seeds. Help children to observe plant populations--bushes, trees, and grass. When they return to the classroom, list the plant populations found.
five containers seeds soil	Put soil in each of the five containers. Label each container and write the conditions for each as given below. Container #1. Place this container in a dark place; water as needed. Container #2. Place this container in light, but do not water. Container #3. Plant too many seeds in this container; keep in light and water properly. Container #4. Plant too many seeds in this container. Do not water and place in darkness. Container #5. This is the control container. Give it all the proper care. Record findings by graphing, charting, illustrating, or writing. Relate these conditions to outdoors.

Concept	Performance Objectives
Conservation. The need to care for and protect organisms.	The child will be able to state three ways people can help conserve plants.

Materials Needed	Learning Activities
plants seeds/bulbs	#If the physical surroundings of the school grounds permit, have children plant flowers or bushes. Or if the hallways have windowed areas, make a window garden with appropriate plants.
	Have children check the school grounds to see whether people are walking through the grass. Ask: How can we teach people to stay off the grass?
	#Invite a naturalist from the Hamilton County Parks to the classroom to discuss conservation. Be sure to call early!
	#Help the children make a terraced garden on a slope to prevent erosion. Discuss why people construct terraced gardens.
	#Have children analyze the litter around the school building. Sort, weigh, and estimate the cost of cleaning up the accumulation from the school grounds.
	#Have children grow plants to sell in order to buy bulbs, a shrub, or a tree for the school grounds.
films filmstrips books study prints	Provide reference materials and have children find out about the contributions of John Muir, George Washington Carver, and Rachel Carson.

Bibliography - Plant Organisms

Baker, Samm. Indoor and Outdoor Grow-It Book. New York: Random House, 1966.

Bulla, Clyde R. Flowerpot Gardens. New York: Thomas Y. Crowell Company, 1967.

Foster, Willene and Pearl Queree. Seeds Are Wonderful. Chicago: Children's Press, 1960.

Frahm, Anne. True Book of Bacteria. Chicago: Children's Press, 1963.

Jordan, Helene J. How a Seed Grows. New York: Thomas Y. Crowell Company, 1972.

Kohn, Bernice. Our Tiny Servants: Molds and Yeasts. Englewood Cliffs, New Jersey: Prentice Hall, 1962.

Podendorf, Illa. The True Book of Plant Experiments. Chicago: Children's Press, 1960.

Rahn, Joan. Seeing What Plants Do. New York: Atheneum Publishers, 1972.

Selsam, Millicent. Vegetables from Stems and Leaves. New York: William Morrow and Company, 1972.

Watson, Aldren. My Garden Grows. New York: Viking Press, Inc., 1962.

Wood, Dorothy. Plants With Seeds. Chicago: Follett Publishing Company, 1962.

Mediography - Plant Organisms

	Division of Resource Services A-V Number
Finding Out About Seeds, Bulbs, and Slips (Basic Primary Science - Group II)	5730
Finding Out How Plants Grow (Basic Primary Science - Group I)	5724
How Plants Help Us	1970
I Like Trees	929
Learning About Flowers	2187
Watch Out for My Plant	6915
What Plants Need for Growth	1500

No. 61606 Ecology: The Pollution Problem - Study Prints (John R. Green)

Now You Know About Plants - Books and Cassette Tapes (Encyclopaedia Britannica Educational Corporation)

Stepping Into Science Book Bag, Predicting With Plants (Children's Press)

SVE Study Prints (Society for Visual Education)
- SP-108 Common Fruits, Group I
- SP-102 Spring Wild Flowers, Group I

ANIMAL ORGANISMS

Rationale

Children are naturally interested in animals. Many have known the affection of a pet and have experienced caring for it. Some have witnessed firsthand or viewed on television an animal giving birth. Most primary children have observed the diversity of animals at the Zoo or on television programs.

Background for the Teacher

There are many different kinds of animals in the world. They vary in size, color, body covering, body structure, food, mode of travel, reproduction, and habitat.

Animals can be classified into two major categories--vertebrate (backbone) and invertebrate (no backbone). The major classifications of vertebrate animals are mammals, amphibians, reptiles, fish, and birds. Invertebrates include earthworms, starfish, sand dollars, snails, and insects.

Mammals are animals which have a protective covering of hair and fur. Since mammals are warm-blooded animals, hair and fur provide, to some extent, protection from excessive heat loss. Hair is said to be a modification of skin; other skin modifications are nails, scales, and feathers.

Frogs, toads, and salamanders are amphibians. They breathe by means of gills in their early stages of development while they are in the water. Later they develop lungs and live on land.

Reptiles usually live on land. They have legs and are covered by a protective covering of scales or scaly plates. They generally hatch from eggs laid on dry land. Snakes, turtles, lizards, alligators, and crocodiles are called reptiles.

Fish live in water and have fins, scales, or bony plates which serve as a protective covering for the body. They use gills for breathing.

Feathers are the distinguishing characteristics of birds. They have two wings, two legs, scales on the feet, and a body temperature usually much higher than that of people. Chickens and turkeys are considered birds.

Animals live in almost any place where they can find food. Each kind has developed certain unique characteristics which help it to survive in its environment. It is important that children recognize the different habitats of animals, whether it be a water environment of the classroom aquarium, the grassy lawn, the crack in the pavement, or the arid desert.

As children care for a variety of animals in the classroom, they should become aware of the diversity in animals, their different nutritional needs, the various kinds of habitats, and the conditions necessary for their survival. As they watch guppies, gerbils, fruit flies, frogs, or mealworms produce another generation, they should become aware that each animal has its own life cycle.

Concept	Performance Objectives
Organism. An individual living thing.	
Animal. One of two main classifications of organisms.	Given a set of pictures of a variety of animals, the child will be able to describe their characteristics.
Characteristics of Animals. Animals have certain properties or attributes.	
Diversity. The way in which organisms are alike or different from one another (characteristics).	
	Given a set of pictures of animals, the child will be able to classify by a chosen characteristic.
	Given specific animals, the child will be able to describe their characteristics.
	Given specific animals, the child will be able to compare their characteristics.
Needs. All organisms have certain requirements in order to sustain life.	Given an animal, the child will be able to demonstrate requirements for life by caring for it.

Materials Needed	Learning Activities
insect net handlens	Take a field trip to a nearby wooded area or park. Have children use the insect net to try to capture such organisms as grasshoppers, moths, butterflies, lady bugs, or spiders. Ask children to describe their characteristics. Ask: How are they alike? Different?
chart paper marking pen	Discuss with children the various animals they know. Record on a chart the characteristics of these animals.
source for pictures	Have children cut out pictures of various animals. Classify according to the animals' body covering, body parts, movement, color, number of legs, antenna/no antenna, or placement of eyes.
animals	Ask children to bring in animals to observe. Record the characteristics of each. Discuss with them how they can group the animals (mammals, reptiles, amphibians, fish).
magazines	Ask children to cut out pictures of animals from magazines. Compare the variety of the animals. Have children give oral reports on the type of pictured animals they found. Ask: In which of the above classifications does it belong?
	Visit the Cincinnati Zoo or the "Wilderness Trail" at the Museum of Natural History. Observe the variety of animals. Describe and compare their characteristics.
	Make arrangements for children to experience the "Bird Program" at the Museum of Natural History.
classroom pets	#Have children hatch and raise a baby chick or duck. Or keep an aquarium or a cage of gerbils, hamsters, guinea pigs, or mice as classroom pets. Contact a local hatchery and pet shop for information about pets' needs. Contact the local SPCA for a tour or a classroom visit.

Concept	Performance Objectives
Change. Differences in organisms over a period of time. Organisms are constantly changing.	The child will be able to describe changes in living organisms.

Materials Needed	Learning Activities
strip of tagboard ruler 20" (51 cm) silhouette of a baby	Make a measuring chart by fastening a long strip of tagboard to the wall. Mark off in inches or centimeters. Cut out a rough silhouette of a baby 20 inches (51 cm) high; fasten it to the bottom of the chart. Measure children against the chart and let them compare their present height with that of the infant.
baby pictures of each child	Ask children to bring in their baby pictures and find out their height and weight at birth. Display the pictures along with birth weights and heights on a bulletin board. Compare these with their present heights and weights.
	Ask children to bring in one piece of evidence that shows they have grown. (The evidence might be an outgrown mitten, dress, shoe, pair of pants, sock, jacket, rattle, or other toy the child is now too old to play with.)
paper pencils	Have children trace their hands on paper; date and save. Repeat later in the year. Compare the growth. Make tracings of parents' or older siblings' hands; compare them with the children's. Serial order the tracings. (Cut out the tracings to make the comparison easier.)
chart paper meter stick or measuring tape	On large chart paper, measure each child; mark the height and label. Repeat procedure at the end of the school year. Compare the change.
caterpillar small tree branches with fresh leaves wide-mouth jar wire mesh screen	Place branches, caterpillar, and a small amount of water in the jar. Cover with wire mesh screen. Make sure the leaves are fresh. (The caterpillar should spin a cocoon or chrysalis and later emerge as a moth or butterfly.)
frog or toad eggs aquarium pond water powdered fish food	Place eggs or tadpoles in a large jar or aquarium filled with pond water or water that has been standing. Change water periodically. Use pond or standing water. Add small amounts of powdered fish food several times a week.

Concept	Performance Objectives
Change. (continued) Differences in organisms over a period of time. Organisms are constantly changing.	The child will be able to describe changes in living organisms.
Birth. The act of bringing forth offspring. Death. The ending of life.	Given an aquarium containing a variety of organisms, the child will be able to describe changes that occur (birth, death, reproduction, and growth).
Growth. The process of increasing in size. Development. An organism passes from one stage of maturation to the next.	Given an animal, the child will be able to record its growth.
	Given a specific animal, the child will be able to describe the changes that occur throughout its growth.

Materials Needed	Learning Activities
pictures of animals	Display pictures of animals at different stages of growth. Describe the changes that occur over a period of time. Ask: How do you think they will change as they grow?
aquarium, guppies dropper, handlens cup, paper rocks or gravel plants (Cabomba, Elodea, Vallisneria)	#Help the class construct an aquarium. Start by introducing rooted plants. Describe these. After several days, add fish. Describe their characteristics--color, shape, size, and how they move. Keep a record of how the fish grow, eat, move, and live. Observe the organism if it dies. Ask: How do you think it happened? Why do you think it died? When do you think it dies? Did we see anything happen that told us it might die?
aquarium	#Keep an aquarium; observe and record the changes.
tadpoles	Allow children to raise tadpoles, mealworms, or caterpillars. Describe and record the changes.
frog eggs or classroom pets camera	Have children record growth of classroom pets by taking pictures with the camera as the organisms develop. Compare.
animal pictures (adult and baby)	Compare the size of the adult animal and the baby.
female crayfish aquarium	Obtain a female crayfish that is carrying eggs attached to her abdomen. Observe where she carries the young after birth. Watch the growth-by-molting process that occurs.
guppies aquaria	Ask children to observe baby guppies as soon after birth as possible and compare their size in relation to the adults. Isolate several babies in a new tank. Observe and record the growth.

Concept	Performance Objectives
Development. (continued) An organism passes from one stage of maturation to the next.	Given a specific animal, the child will be able to describe the changes that occur throughout its growth. Given a specific set of pictures, the child will be able to match the young with the adult.
Extinct. No longer living and having no direct descendents.	
Habitat. The place in the environment where a particular organism normally lives.	Given appropriate materials, the child will be able to construct a habitat for a given animal. Given a set of organisms and pictures of habitats, the child will be able to match the organism with its habitat (underground, above ground, water, desert, woodland).

Materials Needed	Learning Activities
snails, aquaria crayon handlens	Have children observe the snail eggs on the side of the tank. Circle the cluster of eggs on the outside of the aquarium. Observe and describe the changes. Compare the size of the new baby snail to the adult snail.
pictures depicting stages of development of animals	Have children order pictures in sequence of development from egg to adult (egg larva, cocoon, moth; frog eggs, tadpole, and frog).
	Describe the body structure of the young and the adult. Compare the changes in the structures. (This change is called metamorphosis.)
	Discuss with children some forms of living things that have become extinct. (See pages 158 and 159.)
handlens	Take the children on a short trip around the school building. Ask: What evidence of animal life is there? (Look for holes in leaves, tree bark, and the ground. Look under rocks, under leaves and bushes, and in cracks in the pavement.) Discuss and record what was observed.
	Have children search for an environment to study, such as trees, logs, under rocks, or a creek. Ask them to record the organisms they found. Ask: Why are they there? What do they need in order to live?
	#Visit the Cincinnati Zoo. Observe and record how and where each group of animals lives. Observe and/or interview workers at the Zoo.
	Visit the Nocturnal House at the Cincinnati Zoo. Identify the nocturnal animals--those that sleep during the day and seek food at night (raccoons, opossums, bats, owls, and aardvarks). Ask: What special characteristics do nocturnal animals have? (bulging eyes, large pupils, whiskers, large ears, prominent nose, and dark color)
	Visit the Wilderness Trail at the Museum of Natural History. Ask: What different habitats are displayed? Compare the habitats.

Concept	Performance Objectives
Habitat. (continued) The place in the environment where a particular organism normally lives.	Given the materials, the child will be able to set up the necessary conditions for a habitat.
Life Cycle. The sequence of changes as an organism develops from young to an adult.	The child will be able to describe the life cycle of an animal. Given a set of pictures of the stages in an animal's life cycle, the child will be able to arrange them in sequential order.
Genetic Identity. Organisms reproduce their own kind. The similarity between parents and their offspring is due to the transmission of distinguishing characteristics.	Given a set of pictures, the child will be able to match the parent with the offspring.

Materials Needed	Learning Activities
weeds grass	Have children make a pile of cut weeds and grass. Place it in a special area near the school. Several days later, look at the grass and weeds. Ask: What organisms are living in this habitat? What do they need to live?
gallon container sand, net snails, guppies duckweed, eel grass 1 can fish food	Rinse the container well. Fill it 3/4 full of tap water. Let stand at least 48 hours to reduce the chlorine level. Rinse the sand; pour off excess debris and powder. Repeat until the water is clear. Set the plants in the sand. Add guppies, snails, and plants. Ask: What will the fish and plants need to live in this habitat?
paper magazines	Plan with children to draw or construct a mural from magazine pictures showing various animals and their habitats.
	#Obtain a pet, such as a hamster or a gerbil. Set up a cage and get the necessary materials--food, water, wheels, soft paper or shavings. Ask: Why are these needed? What do your pets at home need in their habitats?
chart paper	Discuss with children the life cycle of various animals--mammals, reptiles, amphibians, and insects. Make charts depicting stages in the life cycle of each.
frog eggs or toad eggs aquarium, pond water (If eggs are unattainable, begin with tadpoles.)	Place eggs or tadpoles in an aquarium half filled with pond water. (Tadpoles eat pond scum and algae.) Have children observe the tadpoles and describe the changes. Note: The hind legs develop, front legs appear, tail gets shorter, and the mouth changes shape. When the lungs develop, the frog becomes an air breather and land inhabitant. The frog and toad eat live food--worms and insects.
pictures of adult and young animals	Play a game matching young to adult. Example: cat to kitten, calf to cow, pup to dog, tadpole to frog, caterpillar to butterfly, and mealworm to beetle.

Concept	Performance Objectives
Genetic Identity. (continued) Organisms reproduce their own kind. The similarity between parents and their offspring is due to the transmission of distinguishing characteristics.	Given specific guppies, the child will be able to identify male, female, and offspring.
	Given an organism and the characteristics of its parents, the child will be able to predict the characteristics of the offspring.
Generation. All organisms of the same kind born at about the same time.	Given a species of an organism, the child will be able to keep the species alive through several generations (mealworms, fruit flies, frogs, or guppies).
	Given sets of pictures, the child will be able to trace the life cycle of two generations by arranging the pictures sequentially.
Population. A group of organisms of the same kind living and reproducing in a particular area. Population is determined by the number of individuals in the group and not by the physical size of the individuals.	The child will be able to identify populations of organisms in a natural setting.

Materials Needed	Learning Activities
male and female guppies aquarium	Place a female and a male guppy in a prepared aquarium. Let children observe and care for them. As the offspring are born, have the children describe the similarities and differences between them. (The female is larger and one tint; male is smaller, more colorful, and has a showy tail.)
jar or aquarium	Put some rocks or sand in a large jar or aquarium; add water. Let it stand at least 48 hours to age. Add algae, snails, and guppies. Have children observe and record the growth and population increase. Compare the adult with the offspring.
jar, rocks aged water frog eggs	Set up two jars with rocks, aged water, and algae. Put frog eggs in one jar and tadpoles in the other. Have children observe and record growth and population increase. Keep track of the number of generations.
pictures of life cycles of animals	Have children arrange the life cycle pictures in sequential order. Use pictures of mealworms, frogs, or chickens.
chart paper	#Ask: What animals live in the same community with you? List these on the chalkboard or on a chart similar to the following: Animals in Our Community cats dogs pigeons starlings ants squirrels sparrows gerbils horses goldfish mice rats roaches #Ask: Which ones do people take care of? (Draw a line under each of these.) What would happen to these if people in the community disappeared? Where would the animals live? Where would they find food? (Help children infer that without people some animals would probably die.)

Concept	Performance Objectives
Population. (continued) A group of organisms of the same kind living and reproducing in a particular area. Population is determined by the number of individuals in the group and not by the physical size of the individuals.	The child will be able to identify the environmental conditions that cause an increase or decrease of a population.
Food Chain. A sequence of plants, plant eaters, and animal eaters.	The child will be able to identify organisms that eat plants or other animals in a given habitat.
Plant Eater. An animal that uses plants as a food source.	
Animal Eater. An animal that uses animals as a food source; a predator.	Given a list of animals, the child will be able to classify according to whether they eat meat, plants, or both.
Prey. An animal that is eaten by another.	
Food Web. The pattern in which organisms are interrelated through their feeding habits--plants being eaten by animals and animals being eaten by still other animals.	

Materials Needed	Learning Activities
	Take a field trip to an area in or near the school grounds. Search for evidence of a natural community. Ask: What animals do you see eating seeds or plants? What evidence shows organisms have been partially eaten? (holes in leaves, worms in fruit or seeds, spider webs, bees gathering pollen, or birds pulling worms) What animal populations do you see? (dogs, birds, flies, ants, or cats) When you return to the classroom, list the animal populations found.
"I Found Circles"	Use the "I Found Circles" (see page 273). Place on the ground. Ask: What evidence of organisms are inside the circle? What populations live here?
unusual foods	#Plan a tasting party with the children. Bring in unusual foods or purchase them at Findlay Street Market or a local grocery store. Ask: Where did these come from before they were in the store? What animals live in the same environment? What food do they eat? (Suggested foods: avocado, coconuts, tortilla, palm hearts, kumquats, or pickles.)
	Ask children to name animals they know. Ask: What do they eat? Are they plant eaters or animal eaters? Where do they get their food? Make a list of what animals eat. (Specify the availability of food.) Ask: If certain foods are not available, what will the animals do?
caterpillar small leafy branch large glass jar or screened enclosure small wet sponge	Place in an airy container a caterpillar and a leafy branch (from the tree on which the caterpillar was found). Place the sponge on the floor of the container. Ask: What does the caterpillar eat? (fresh leaves) Note: The leaves will stay fresh longer if the stem is placed in a small jar of water. Leaves should be gathered every few days.
fish food for fish	Have children feed a fish different foods and observe what he eats. (Put the fish in a separate bowl during the experiment.)
guinea pig or rabbit bean, cabbage, or carrot plant	Provide suggested plants. Place near the animal. Ask: What happens? (The animal will probably devour it quickly.)

Concept	Performance Objectives
Food Web. (continued) The pattern in which organisms are interrelated through their feeding habits--plants being eaten by animals and animals being eaten by still other animals.	The child will be able to represent a "food web."
Conservation. The need to care for and protect organisms.	The child will be able to state three ways people can help conserve animals.

Materials Needed	Learning Activities
paper crayons	Have children construct a food web mural of their community showing plant and animal populations.
	Visit the Wilderness Trail at the Museum of Natural History. Observe the animals displayed. Discuss the kinds of food each one would eat.
	#Invite a Hamilton County Park Naturalist to the classroom to discuss conservation. Be sure to call early!
	On a visit to the Zoo, find the animals which have the symbol of the vanishing animal posted on their habitats. Discuss the causes of the decline in wildlife.
	Make reports on animals that have been placed on the Endangered Species List.
bird feeders	#Help the children set up a bird feeding station outside the classroom window or near the school building. Construct birdhouses or feeders.
	#Visit the Cincinnati Zoo. Discuss how and why the Zoo strives to protect, conserve, and breed animals. Interview a worker at the Zoo. Find the qualifications needed and the responsibilities of his occupation.
films, filmstrips books, study prints	Provide reference materials and have children find out about the work of John J. Audubon.
	#Visit the Cincinnati Nature Center. Report on ways nature preserves try to conserve animal life.
	#Write the National Wildlife Federation for information on conservation.
	#Report on workers whose jobs involve monitoring conditions to make the environment safe for animals, such as industrial waste in rivers and streams.

627

628

Bibliography - Animal Organisms

Conklin, Gladys. *I Like Caterpillars*. New York: Holiday House, Inc., 1958.

Cosgrove, Margaret. *Eggs and What Happens Inside Them*. New York: Dodd, Mead and Company, 1966.

Freschet, Bernice. *The Flight of the Snow Geese*. New York: Crown Publishers, Inc., 1970.

Harris, Louise Dyer and Norman Dyer. *Flash: The Life Story of a Firefly*. Boston: Little, Brown and Company, 1966.

Miller, Patricia and Iran Seligman. *Big Frog, Little Frogs*. New York: Holt, Rinehart and Winston, Inc., 1962.

Reit, S. V. *Animals Around My Block*. New York: McGraw-Hill Book Company, 1969.

Selsam, Millicent E. *Egg to Chick*. New York: Harper and Row Publishers, Inc., 1970.

Simon, Hilda. *Milkweed Butterflies*. New York: Vanguard Press, Inc., 1969.

Wong, Harry and Matthew Vessel. *My Goldfish*. Reading, Massachusetts: Addison-Wesley, 1969.

Mediography - Animal Organisms

	Division of Resource Services A-V Number
Animal Tracks and Signs	62
Animals and Their Food	1953
Animals and Their Homes	1954
Animals in Autumn	2186
Animals in Spring	1950
Animals in Winter	1545
Animals, Ways They Eat	2100

	Division of Resource Services A-V Number
Animals, Ways They Move	1595
Birds: How They Live, Where They Live	510
Common Animals of the Woods	1312
Familiar Animals and Their Families	5771-5776
Finding Out How Animal Babies Grow (Basic Primary Science - Group I)	5725
Gray Squirrel	1010
How Animals Help Us	1971
Let's Find Out About Animal Babies (Science, Let's Find Out)	10674
Living and Non-Living Things	2185
Nature's Half Acre	756
Water Life - Keeping An Aquarium	2291

No. A141 Baby Animals of the Wild - Study Prints (The Child's World)

No. 49494 Birds of Our Land - Pictures (John R. Green)

No. 68536 Ecology: Ecosystems - Study Prints (John R. Green)

Now You Know About Animals - Books and Cassette Tapes (Encyclopaedia Britannica Educational Corporation)

SVE Study Prints (Society for Visual Education)
- SP-104 Common Birds, Group I
- SP-101 Common Insects, Group I
- SP-117 Familiar Birds, Their Young and Nests
- SP-163 Insects of Garden and Cropland
- SP-161 Large Animals of North America, Group I
- SP-162 Large Animals of North America, Group II
- SP-107 Moths and Butterflies, Group I
- SP-105 Pets
- SP-111 Reptiles and Amphibians
- SP-103 Wild Animals, Group I